PROGRESS REPORT

(10/1/81 - 9/30/82)

Saval Ranch Research and Evaluation Study

Submitted to

Saval Ranch Steering Committee

in accordance with

Master Cooperative Agreement

among

USDI - Bureau of Land Management

USDA - Forest Service

USDA - Soil Conservation Service

USDA - Agricultural Research Service

Saval Ranching Company

in cooperation with

Nevada Agricultural Experiment Station

Nevada Department of Wildlife

U.S. Geological Survey

April 1983

PROGRESS REPORT

Saval Ranch Research and Evaluation Study

Errata Page

Page

1. Vegetation Research, line 4. Seventy-six instead of sixty-six.

3. Line 4. Deborah not Debra.

17. Snow Survey, line 1. ...equivalents were measured...

29. Para. 6, line 7. ...but made up...

33. Para. 1, line 1. (early summer grazing).

50. Para. 5, line 6. ...were hand plucked...

53. Para. 8, line 4. ...deer consumption.

60. Para. 2, line 11. specifically instead of especially.

64. Table 5.3 $\bar{x}$ total and % for 1982/grazed treatment should be 82.6 (100).

66. Para. 3, line 3. Delete some.

80. Footnote 8, line 2. genetic instead of genetric.

98. Para. 5, line 9. ($P < .01$).

100. Para. 1, line 2. ($P < .01$).

105. Para. 4, line 3. ...1983 livestock...

121. Literature cited is for Chapter 9.

123. Para. 6, line 5. development.

128. Artiodactyla instead of Artiodactyal.

IN REPLY REFER TO

4400 (NV-010)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

ELKO DISTRICT OFFICE
P.O. Box 831
Elko, Nevada 89801
702-738-4071

Bureau of Land Management
Denver Service Center
Director, (D-470)
Denver Federal Center
Bldg. 50
Denver, CO 80225

Dear Sirs:

Enclosed is a copy of the 1982 progress report for the Saval Research Project in the Elko District. The Saval research effort has been in existence since 1978. The Introduction and Executive Summary for the progress report provide a general background discussion and items of accomplishment to the present time for what is presently the Bureau's largest research effort. We intend on distributing copies of the annual progress report to each BLM state office, each Nevada BLM district office, and other interested groups in order to make others aware as to what research efforts are being conducted.

If you would like more information about the Saval project, the project coordinator is Terry Dailey, and he can be reached at telephone number 702-738-4071.

Sincerely yours,

Rodney Harris

RODNEY HARRIS
District Manager

Enclosure (1)
Encl. 1 - As stated above

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. Climatology Research- Precipitation, temperature, humidity, evaporation, solar radiation, dew point temperature, wind speed and direction, and snow depths were monitored at climate stations installed in 1978. Station 11 was upgraded this year with the installation of a continuous recording evaporation pan system. This will allow for more detailed monitoring of daily evaporation rates. Precipitation gauges at all stations were cleaned and calibrated this fall.

Calendar year precipitation totals ranged from 15.23 to 39.32 inches and are estimated to be 110 to 120% of normal. These above average totals were not due to an increase in any specific quarter of the year, but were a reflection of above average precipitation throughout the year. Using simple linear regression, the correlation between station elevation and precipitation was 87%. This relationship can be used to estimate precipitation for sites distant from climate stations. The largest single storm event of the year occurred on September 10, and produced 1.38 inches of precipitation at station 6. Climate station 3 recorded the highest intensities during this storm - 1.45 and 0.56 inches per hour for the 15 and 60 minute durations, respectively. This roughly corresponds to the 3-year event for the area.

Maximum recorded temperature was 94°F in August. A minimum of -42°F was recorded in February. Mean pan evaporation rates at stations 2 and 11 were 0.21 and 0.23 inches per day, respectively (John Barber).

2. Vegetation Research- In 1982, 28 additional transects were established to monitor vegetation trend of grass, forb and shrub species by frequency, canopy cover and density; and soil trend by ground cover characteristic. Total number of trend transects is now 159. Seventy ~~Sixty~~-six additional transects will be established before the grazing system starts in 1985.

Herbaceous production was sampled on 23 areas, representing 12 important range sites, during the 1982 growing season. Plant growth was slow this spring due to cold temperatures in March and April. When temperatures warmed up, production by the end of June was almost twice that of 1981 due to abundant and extended growing-season moisture. Most areas received more than twice the moisture from September 1981 thru June 1982 than during the same period in 1981. Production on Forest Service wet meadows declined this year in contrast to other range sites. Soil on these meadows remained very wet throughout the growing season. This condition may have suppressed plant growth due to lack of oxygen or cold temperatures in saturated soil.

Grazing use on the various range sites was estimated by utilization classes to identify cattle preferences among range sites, changes in species and range site preferences during the grazing season, and differences in species and range site preferences between 1981 and 1982. Spring was very cold in 1982 and plant growth was slow during the grazing period on crested wheatgrass seedings. Use was severe at the end of the grazing period. Weather warmed up after cows were moved and, with abundant soil moisture, regrowth was excellent. Use was light to moderate on most range sites in the Lower Mahala, Middle Mahala and Upper Sheep Creek pastures. Sandberg bluegrass, a common species in

these pastures, was the most preferred upland grass species. Over the past 3 years, utilization on range sites in the early summer-use Forest Service pasture has been higher than on the same range sites in the late summer-use Forest Service pasture. The California Creek area was abused in 1981 due to lack of water. This area recovered well in 1982 due to the late grazing period, good growing season, and moderate utilization.

Success of the Lower Sheep Creek Seeding was evaluated. These data were used to estimate the success of the total seeding. Approximate acreages in each success class were: Excellent - 220, Good - 430, Fair - 1530, and Poor/Failure - 250. Poor stands and failures were found on Claypan and Ridgetop Range Sites and on north slopes that had muddy or frozen soil at time of plowing and/or seeding (D. Waive Stager, Richard E. Eckert, Jr., and Russell T. Dailey).

3. Sage Grouse Research- Sage grouse populations were monitored through strutting ground counts and hunter harvest data. Both methods indicated that 1982 was the third consecutive year that grouse populations declined on the Saval Project Area. A low ratio of juveniles to females in the fall harvest, a high percentage of unsuccessful females based on wing molt patterns, and brood surveys conducted during summer months indicated that the decline was due to low production and/or survival of young birds rather than to high mortality of adult birds.

Habitats used for nesting, brood-rearing, and feeding-loafing were identified through telemetry procedures. Habitats were sampled to determine species frequency, canopy cover by species, and ground cover. The characteristics of the habitats used by sage grouse on the Saval are comparable to habitats used in Colorado, Montana, Idaho, and elsewhere in Nevada.

The vegetation mapping to determine habitat availability was nearly completed in 1982. Thirty-eight vegetation types have been identified and mapped to a two-acre resolution. The completed mapping project will be used to determine the availability of habitats so habitat preferences can be determined. The mapping project will also provide a basis for establishing a stratified sampling scheme for quantifying vegetation characteristics.

Sage grouse movements and distribution were determined primarily through trapping and telemetry operations. Home ranges of females with broods and broodless females were determined. Mean weekly movements for all birds were also calculated.

The observations to date have led to several hypotheses that can be tested. In addition, a study to determine the influence of climate on winter habitat use is planned for winters 1982-83 and 1983-84 (Mack R. Barrington and Gary N. Back).

4. Mule Deer Research- Early in June, forbs were the principal forage selected by tame mule deer. Individual deer selected a diet as high as 94% forbs at this time. By late June, in some cases, or early July, shrubs became more important. Shrubs made up from 34 to 90% of the deer diets at that midsummer date. By late summer, deer were essentially browsers with shrubs

ranking as high as 86 to 97% of the diet. Variation between deer occurred. The buck favored shrubs at all times; all does consumed more forbs.

The impact of cattle grazing was undetected. Pasture differences in diets obscured any grazing impact (Debra Selby and Donald A. Klebenow).

5. Non-Game Research- A total of 578 rodents were live-trapped on 18 grids. Trapping effort was concentrated on BLM pastures, with special emphasis on the new mixed-species seeding. Over-all, total rodent population was 43% lower than in 1981. Rodent abundance was lower on the seeding than on a control grid. Least chipmunks were virtually absent on the seeding grid, apparently in response to sagebrush removal by plowing.

We conducted 16 bird transects in 7 pastures. Emphasis was placed on sampling riparian habitats in Forest Service pastures. Fox sparrows and song sparrows were much more abundant in the Gance Creek area than in any other drainages sampled. Mourning doves were noticeably more abundant along the Mahala Creek transect. These differences are no doubt due to habitat variation.

An effort was also made to determine the effects of the new seeding on bird populations. Brewer's sparrows and gray flycatchers (both shrub-nesters) decreased on the seeding, apparently due to a reduction in sagebrush cover. However, ground-nesting horned larks increased after habitat conversion, responding positively to the more open habitat created.

Black-tailed jackrabbit densities this year were the lowest documented on the study area since 1978. Because of these low numbers, utilization of vegetation on the seeding by jackrabbits was also low (1.3 lb/ac). (J. Kent McAdoo and Donald A. Klebenow).

6. Fisheries Research- The 1982 season marked the completion of 5 years of study on Gance Creek, Nevada, in performance of the fisheries research portion of the Saval Ranch Project. Few clearcut benefits of the livestock exclosure that was built to protect 600 ft. of stream channel and associated riparian habitat are as yet evident. We attribute the lack of rehabilitative response to two principal factors: first, the exclosure has not been completely effective in preventing livestock use in the experimental site; and, secondly, natural geoclimatic variability has been exacerbated by general watershed deterioration above the exclosure, which is not large enough to control the effects of these upstream conditions sufficiently to encourage positive responses in native trout populations. The native cutthroat trout, however, are apparently sufficiently well adapted to the naturally fluctuating environment that they have been able to survive this increased variability and suboptimal fishery conditions, and exhibit a marked ability for population rebound during periods of favora'le conditions. With additional study of the protected riparian and stream habitat within the exclosure we expect to be able to identify critical trout habitat changes and increase management expertise (William S. Platts and Rodger Loren Nelson).

7. Hydrology Research- All available precipitation charts through 1982 were marked, digitized, and information entered into a computer data base.

Rainfall energy indexes for soil erosion prediction were determined for all storms at each climate station. Rainfall simulation was used to test the Universal Soil Loss Equation (USLE) for prediction of soil erosion from a claypan range site. For individual simulated storm events, predicted soil erosion ranged from 23 to 215 percent of the measured value. Streamflow recorder charts were inspected for errors, and runoff data are currently being entered into a computer data base. Suspended sediment and streamflow data were analyzed, and flow-duration and sediment load-duration curves were constructed for several stream sampling sites. Four small watersheds were instrumented with flow-measurement and recording devices. Vegetation production and cover were sampled on two previously-instrumented watersheds. A herbage yield computer model was tested on a site south of the study area. Historical production values were predicted and relative yields estimated for other years (Steven A. Loomis and Keith R. Cooley).

8. Livestock Research- Birth date and weight were recorded for 61 calves during March, 1982. Mean birth weight for these calves was 70 pounds. Weaning weights of the 1982 sampled calves were significantly ($P < .05$) heavier than for 1980 and 1981 calves. Mean 205-day weight for 1982 sampled calves was 415 pounds. The 205-day calf weight will be used in the future to test for differences in weaning weights among years and grazing systems. Average daily gain of calves from birth through weaning was 1.68 pounds per day. Percent conception, determined in October 1982, was 68 percent. The Saval cow herd weaned a 59% calf crop.

Fistulated cattle diets in 1981 collected before and after cattle use on the Upper Sheep Creek pasture showed no difference in overall percent grasses, forbs or shrubs. The diet collected after cattle use on the North Forest Service pasture indicated a 25% decrease in grass or grasslike species and a 29% increase in shrub species when compared with the diet before cattle use. Diets after late cattle use on the South Forest Service pasture showed a 15% decrease in grass or grasslike species and an 8 and 9% increase in forbs and shrubs, respectively, when compared with the diet collected before cattle use on this deferred pasture.

Rumen and fecal samples were collected on the Lower and Middle Mahala, Control Crested Wheatgrass, Control Native, South Forest Service, North Forest Service and East Darling pastures during 1982. The chemical and botanical analyses of these samples were not completed in time for this report (Lynn K. Winer and Charles F. Speth).

9. Economic Research (Ranch)- "Typical" annual livestock ranch production costs for the Saval Ranch were summarized from the 2 years of economic data. From these data, and data supplied by other disciplines of the Saval research team (i.e. livestock and range groups), a "representative" ranch income statement was compiled. A corresponding linear programming (LP) model was developed. Using the model, alternative livestock management schemes under season-long grazing were analyzed. An economic analysis of the proposed Saval Ranch grazing system was also conducted. Ranch labor data were compiled to allow the monitoring of changes in labor costs resulting from the grazing system. The costs of the various range improvements implemented during 1981 were estimated.

It was estimated that to maximize profits the Saval Ranch should switch to a cow-calf/yearling operation whereby all steer calves are kept on the ranch through the winter, the following grazing season, and sold as long-yearlings. The option to purchase additional stocker calves for the summer grazing period also appears very profitable. Development of additional winter feed, the most limiting and most expensive forage resource for the Saval, would be the most profitable improvement practice. Without additional winter feed, all anticipated forage increases from the grazing system would not be used beneficially under profit-maximizing livestock production (Allen Torell).

10. Economic Research (Non-Firm)- Economic research not directly involving the ranch firm was directed to background studies in preparation for future analysis of the project. A study plan was prepared, a comprehensive literature review initiated, a major range economic symposium was held and major data sources and related information was located (Fred J. Wagstaff).

11. Research design, integration, and synthesis- A contractor's progress report entitled "Saval Ranch Research Design, Integration and Synthesis - Modelling Workshop Report" was distributed to those involved with and interested in the Saval Project. The report described workshop-modelling procedures, and briefly described the components and a few of the principal functional relationships used in the model. It also gave examples of types of scenarios that can be run in which the model evaluates possible results of specific management actions on the simple representation of the ranch system. It simulates effects of specific management actions on selected indicators for up to 30 years.

It is recognized that this overall system model is still very crude and needs improvement. However, the contractors and Saval project personnel agreed that it would be more fruitful to shift attention to development of smaller submodels that could be run on micro-computers, such as the Apple II in the Elko project office. Rationale for developing these was, in part, that personnel relatively unsophisticated in programming and computer use would be more likely to use simpler submodels. Also, cost of using such submodels is considerably less than running the whole model on a mainframe computer.

Two submodels have been developed: 1) to predict plant growth in various vegetation types based on precipitation and soil moisture, and 2) to predict abundance of key passerine "indicator" species based on changes in percent cover of principal vegetative layers (Peter Lent).

INTRODUCTION

The Saval Ranching Company is a privately owned enterprise located in northeastern Nevada. The ranch, livestock and grazing allotment were made available for this interdisciplinary study. Funding is provided by the Bureau of Land Management, U.S. Forest Service, and Agricultural Research Service.

The Saval Ranch Research and Evaluation Study was initiated in May, 1978. The overall objective is to evaluate the effects of livestock grazing management systems and necessary range improvement practices on livestock production, vegetation, fish and wildlife and their habitat, watershed hydrology, water quality, economic factors, and other resource values on the Saval Ranch Allotment. This allotment contains 59,000 acres; 14,000 acres are privately owned, 28,000 acres are managed by the Bureau of Land Management, and 17,000 acres managed by the Forest Service.

A Steering Committee is responsible for development of overall plans and actions needed to accomplish the study. This committee consists of technical representatives from each Federal agency involved, University of Nevada College of Agriculture Cooperative Extension Service, Nevada Department of Wildlife, Nevada Cattleman's Association, and the Saval Ranch owner and manager.

Progress since 1978 includes an Order III Soil Survey, a delineation of range sites classified to range condition, a SVIM Inventory, a Cultural Resource Inventory, collection of baseline data on all resources, an Environmental Assessment, a Coordinated Management Plan, and various range improvements. The Management Plan includes an interim grazing schedule from 1981 to 1984. Full implementation of the management plan is scheduled for 1985 and will include season of use, rest, deferred, and no-grazing treatments. Figure i.1 shows the existing pasture system on the Saval Allotment. The scheduled grazing use, actual use, and estimated AUMs for the 1982 grazing season are presented on page 8.

This interim report summarizes progress and results for the period October 1, 1981 through September 30, 1982. Data collection, analyses, and reporting are according to the Master Memo of Understanding and the 1982 Work Plan.

Common names for plants and animals are used in this Report. Scientific names are given in Appendix I for plants and Appendix II for animals. The English system of measurement is used in this Report. Factors to convert these measurements to the metric system are presented in Appendix III.

Hydrology and modeling research were funded separately by BLM and were not a part of the 1982 Work Plan. However, we have included progress in these studies to show the total research effort.

Additional copies of this Report or further information on work in progress can be obtained from:

Richard E. Eckert, Jr.
Agricultural Research Service
Renewable Resource Center
University of Nevada, Reno
920 Valley Road
Reno, Nevada - 89512

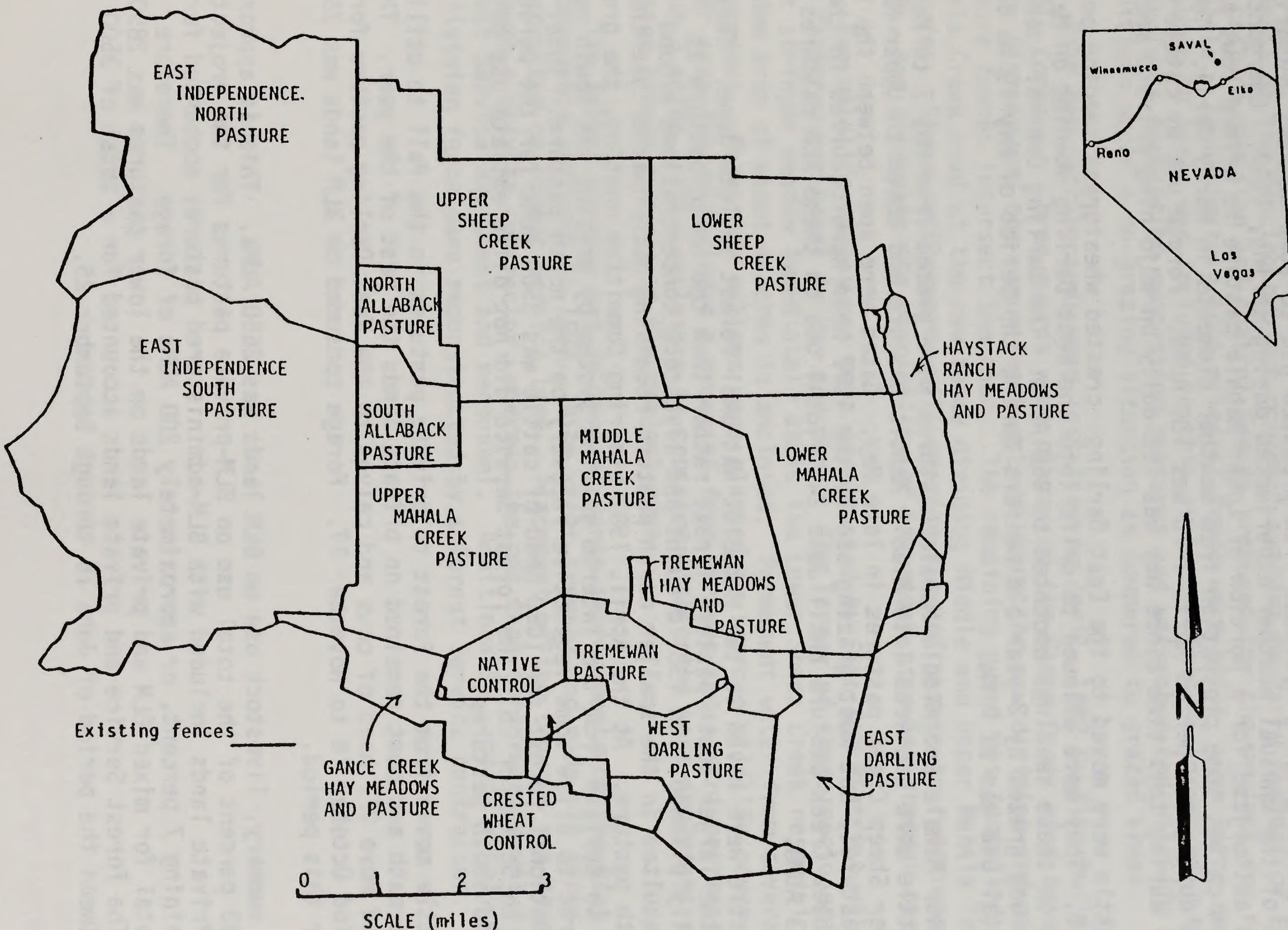


Figure i.1. Native and seeded rangeland and hay meadows on the Saval Allotment.

1982 Livestock Grazing Use

Livestock grazing deviated from proposed use to some degree, primarily because of the unusual weather experienced during spring, 1982. Emergency use was authorized for a portion of Lower Mahala pasture to afford cows and new-born calves some protection from weather elements in early April. Total BLM use during the period April 1-10 was 109 AUMs. Forage use by cattle was minimal during this time since hay was fed daily on adjoining private meadows.

Cattle were moved to the East Darling crested wheatgrass seeding on April 16. They were allowed to drift into the West Darling seeding on May 1. BLM use on these seedings amounted to 968 AUMs. The Darling Control (seeded) pasture was grazed by 2-year old heifers during the period of May 19 to June 26. Total use was 82 AUMs.

Lower Mahala and Middle Mahala pastures were grazed from May 7 to May 25. Cattle were gathered into Middle Mahala pasture and moved to Upper Mahala and Upper Sheep Creek pastures in late May. Gates were open between the two upper pastures, but most grazing use by the 1077 head herd occurred in the Upper Sheep Creek pasture until June 24. Total use on these BLM pastures was 1233 AUMs.

Cattle were moved to the Humboldt National Forest in late June. They grazed the larger south pasture first, rather than the north pasture as originally planned. In 1981 drought and livestock concentrations around water resulted in the smaller north pasture receiving much heavier use than the south pasture. At the April, 1982 Steering Committee meeting, the group decided to deviate from the interim grazing system by grazing the south pasture first to allow some vegetative recovery on the north pasture. Total use on the National Forest for 1050 head of cattle was 3500 AUMs for the period June 16 to September 25. The Forest Service did not differentiate use between north and south pastures.

Cattle moved from the Forest to private pastures in the fall to utilize hay aftermath and most remained on private lands the rest of the year. The ranch did move 277 head of cows and calves to the West Darling pasture for the period October 18 to November 17. Forage consumed on BLM lands was 258 AUMs for this period.

In summary, livestock use on BLM lands was 2650 AUMs. This is approximately 93 percent of the total use on BLM-private pastures for the project area. Private lands included with BLM-administered pastures accounted for the remaining 7 percent, or approximately 200 AUMs of forage. Therefore, the grand total for mixed BLM and private lands on the lower pastures was 2850 AUMs. The Forest Service and private lands accounted for a total of 3500 AUMs between the period of June 16 through September 25.

1982 Range/Wildlife Projects

Range improvement projects on BLM lands in 1982 consisted of completion in April of the fencing project contract awarded to Parry Sargent of Elko. All pasture division and control fences proposed for the project are now complete. Approximately 10.5 miles of fence were built. One large exclosure of about 40 acres was included in this project. This exclosure will be used to evaluate vegetation succession patterns and watershed and wildlife habitat conditions under a no-grazing situation as compared to grazed areas.

Four new cattleguards were installed in April, 1982 by Elko Building Supply Company. Three guards were placed on the Gance Creek road between state highway and the ranch headquarters where the new division and control pasture fences intersect the road. The remaining guard was installed on the Mahala Creek road at the new fence dividing Middle and Upper Mahala Creek pastures. These cattleguards will provide ease of access to researchers and users, and eliminate the possibility of livestock straying through open gates.

Two wildlife exclosures were constructed by Elko BLM District wildlife and firecrew personnel in May and June. The larger of these encloses a remnant stringer meadow immediately above the Lower Sheep Creek reservoir. A meadow area of about 4 acres is enclosed. Permanent water from several seeps is present. Roses and willows were planted to improve wildlife cover. The other area fenced included a group of four springs and a stringer meadow of about 3 acres. This exclosure is centered within the most important complex of sage grouse grounds on the project area.

The Forest Service put in several range improvements on the East Independence pastures in 1982. Nine water troughs and nine pit tanks were constructed on Forest Service land. Placement of the troughs was done through a private contractor, whereas the pit tank construction was done with Forest Service equipment and personnel. Additionally, approximately 4 miles of division fence were reconstructed by a Forest Service contractor.

ANNUAL WORK PLAN FOR FY 82

Work Plan for FY 1982. ARS, during 1982, will perform the following monitoring and research studies on the Saval Research and Evaluation Area.

1. Climatology

Continue data collection for precipitation, temperature, evaporation, relative humidity, wind speed and direction, dew point, and solar radiation with existing instrument network. Continue sediment sampling and discharge measurements at selected sites on Gance, Jim, Mahala, and Sheep Creeks.

2. Vegetation

Continue data collection on existing trend plots and establish additional plots on extensive and/or important upland and riparian range sites. Continue monitoring phenology, forage production, and utilization of forage species on important range sites. Evaluate the success of plow/seed manipulation on Lower Sheep Creek Pasture.

3. Sage Grouse Habitat

Develop a detailed vegetation map of the Mahala Creek Pastures. Characterize each vegetation type present in terms of plant species, composition, and structure. Characterize habitats used by sage grouse in these pastures. This will provide a basis for comparing existing habitats and populations with habitats and populations following implementation of new grazing systems and habitat manipulation practices.

4. Mule Deer Habitat

Continue research on diet overlap of mule deer and cattle and how diet is influenced by forage availability and utilization within deferred-and rest-rotation grazing systems. Trained mule deer will be used in this study. A total of 10 range sites in poor, fair, and good condition will be sampled as a minimum. Sampling will take place at least in spring, summer, and fall. Both forage utilization and forage availability will be determined. Fecal samples from tame and wild deer and from cattle will be collected and compared for diet overlap.

5. Non-game Species

Continue intensive sampling of non-game wildlife populations in key plant communities and by representative species to determine density of rabbits, rodents, and birds in response to grazing-induced changes and to manipulation practices.

6. Livestock

Intact and fistulated steers will be used to evaluate the botanical and chemical characteristics of cattle diets on the major grazing areas on BLM and FS lands during FY 1982. Chemical analysis

of samples from FY 1981 will be completed. Botanical comparisons will be made between range cow feces and the feces from test steers in order to evaluate the technique. Birth weight will be determined and an electronic scale will be used to monitor periodic cow and calf weights during the grazing period. Gross animal grazing behavior associated with major physical characteristics of the allotment will be evaluated. Observations will be coordinated with the economic and wildlife program areas where appropriate.

7. Economics

Repeat the budgeting analysis for the Saval Ranch in order to determine average yearly costs of production. Continue development of a linear programming model for the Saval Ranch. The objective is to develop a model that will provide more efficiency and accuracy than the COPLAN model. The development of the Input/Output model will continue with preliminary testing this fiscal year.

CHAPTER I

CLIMATOLOGY RESEARCH

John Barber

1982 Objectives

1) To document the climatic characteristics of the study area.

2) To provide a reference for extrapolation of resource data to other sites.

3) To provide climatic data input to other study disciplines.

1982 Accomplishments

A climatic monitoring network was designed and installed on the Saval Ranch in 1978 (Fig. 1.1). The network, consisting of 11 climate stations, was designed to measure the climatic variability due to topography, elevation, and storm patterns which occur on the study area. Elevations of the stations range from 5950 feet at Station 11 to 7820 feet at Station 9 (1981 Progress Report).

Precipitation gages at all 11 stations were cleaned and re-calibrated in September with the assistance of personnel from the Agricultural Research Service in Boise, Idaho.

An automatic recording system was installed on the existing evaporation pan at Station 11 in September. The system is explained in more detail in the evaporation section.

Climatic data is used in the Saval systems model to drive various relationships, including soil moisture, overland flow, and forage production. The data can also be used to correlate climatic events with wildlife population responses and irrigation water availability.

Precipitation

Quarterly precipitation totals for the 1982 water year and calendar year are listed in Table 1.1. The values are summaries of storm data as provided by the Agricultural Research Service in Boise after marking and digitizing the precipitation charts. A daily breakdown of precipitation is available for all stations. The apparent difference between the 1982 water year and calendar year totals were due to the significantly higher 1981 fourth quarter precipitation totals, as compared with 1982 fourth quarter totals.

Water year and calendar year totals are compared with the last 2 years in Table 1.2. Precipitation totals were notably higher this year than the past several years of record. Elko and Owyhee weather stations reported totals 130% and 100% of normal, respectively. Precipitation totals for the Saval Ranch in 1982 were estimated to range between 110% and 120% of normal. This above average total was not due to an increase in any specific quarter of the year, but was a reflection of above average values throughout most of the year.

The higher than average values recorded in the fourth quarter of 1981 and the first two quarters of 1982 probably had a positive effect on 1982 forage production. The winter snowpack recharges the soil moisture in the spring, resulting in water available for use by vegetation.

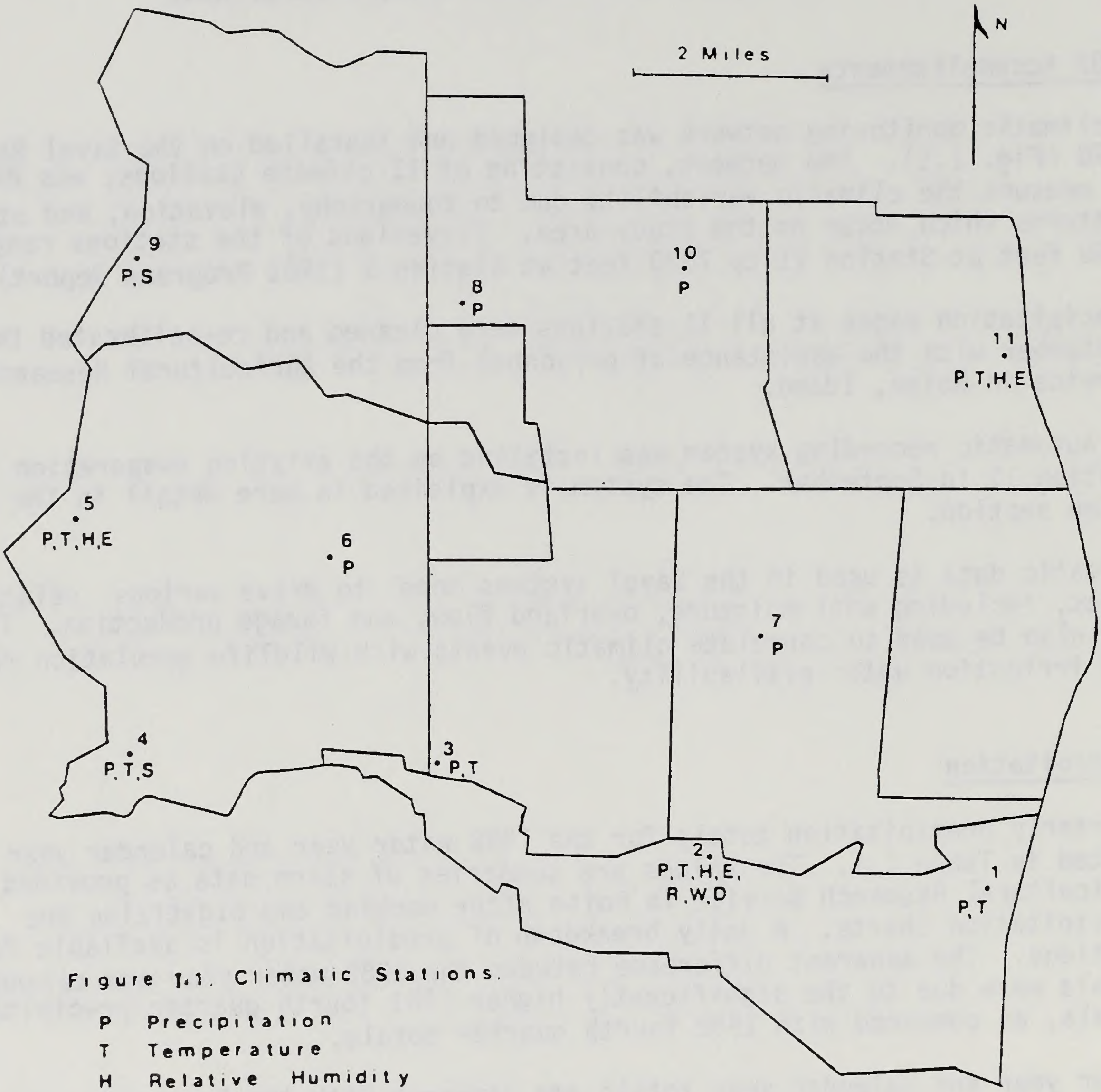


Figure 1.1. Climatic Stations.

- P Precipitation
- T Temperature
- H Relative Humidity
- E Evaporation
- R Solar Radiation
- W Wind Speed and Direction
- D Dew Point Temperature
- S Snow Course

Table 1.1. Precipitation totals for the Saval study area (in inches).

	Climatic Stations										
Quarter	1	2	3	4	5	6	7	8	9	10	11
1981-4	6.57	6.47	8.07	12.40	17.54	10.20	7.15	9.75	15.08	7.01	6.94
1982-1	4.15	4.14	5.38	9.16	13.48	6.07	4.44	5.80	9.59	3.90	4.12
1982-2	3.15	2.33	2.71	3.49	4.57	3.21	2.41	2.95	4.21	3.01	2.33
1982-3	4.59	4.55	4.74	5.85	7.34	6.46	4.70	4.45	7.20	4.58	4.28
1982-4	4.38	4.29	5.63	8.64	13.92	5.88	4.86	6.49	10.14	4.94	4.62
Water Year 1982 Total	18.47	17.50	20.90	30.90	42.94	25.22	18.70	22.96	36.09	18.50	17.68
Calender Year 1982 Total	16.28	15.32	18.46	27.14	39.32	20.90	16.41	19.70	31.15	16.43	15.36

Table 1.2. Comparisons of Precipitation values at 11 stations for water and calendar years, 1980, 1981, and 1982 (in inches).

Station	Water Year 1979-1980	Water Year 1980-1981	Water Year 1981-1982	Calendar Year 1980	Calendar Year 1981	Calendar Year 1982
1	14.61	6.05	18.47	13.30	11.29	16.28
2	13.26	6.22	17.50	12.50	11.23	15.32
3	15.31	8.13	20.90	13.91	14.28	18.46
4	23.46	13.39	30.90	21.79	22.68	27.14
5	33.08	21.61	42.94	32.87	32.55	39.32
6	-[1]	10.68	25.22	13.53	18.03	20.90
7	13.76	6.48	18.70	12.66	12.43	16.41
8	13.96	9.01	22.96	13.44	16.01	19.70
9	27.71	18.53	30.09	26.85	27.93	31.15
10	13.09	6.58	18.50	11.93	11.91	16.43
11	13.82	6.24	17.68	12.63	11.93	15.36

[1] The station was moved during this period, no data recorded.

The relationship between average annual precipitation and station elevation is shown by the regression in Figure 1.2. The annual precipitation totals were based on the 1980 through 1982 water year totals and do not include Station 6, which was moved during the period. This relationship may be used to estimate precipitation for sites at other elevations on the study area.

Individual storm depths, duration, and intensities are available for each station for the years 1980 through 1982. During calendar year 1982 the largest single event occurred on September 10. The storm produced 1.38 inches of rainfall at climate station no. 6 (see Figure 1.1). Climate station no. 3 recorded the highest intensities during the storm. Intensities of 1.45 and 0.56 inches per hour were measured for the 15 and 60-minute durations, respectively. This roughly corresponds to the 3-year event for the study area (see Figure 7.2 of the 1981 Saval Progress Report).

The average probability of a given amount of precipitation occurring during a particular month or growing season is useful in planning range improvements such as seeding and spraying. Long-term precipitation records generated from statistical characteristics of actual data can be used in management simulation and forecasting models. An example of this type of information available for the Saval study area is presented in Figure 1.3. The curves are based on 3 years of precipitation data at climate station 5. The figure indicates that during the month of August, 93 percent of the days have rainfall less than .01 inch, and only 4 percent have rainfall greater than .10 inch. Probability data are available for all stations and any desired precipitation amount.

Snow Survey

Snowpack depth and water equivalent is measured approximately biweekly at three sites on the study area. The sites are near climate stations 4, 5, and 9. Depth, water equivalent, and snowpack density data are available, but not presented here.

The depth of snow and period of time that snow remains on the ground at various elevations may be potentially useful in relating wildlife population numbers to the severity of winter weather.

Temperature and Relative Humidity

Monthly maximum and minimum temperatures for both the water year and the calendar year for all six thermograph stations are given in Table 1.3. Summer high temperatures on the project ranged from the mid 80's to the low 90's with a maximum of 94 degrees recorded at Station 1 in August. Winter lows ranged well below zero with -42 degrees being the lowest temperature, recorded at Station 1 in February. Daily temperatures are not presented here, but are available upon request.

Relative humidity was recorded at three stations on the study area. Winter minimum values commonly fluctuate between 30% and 40%, while summer lows between 10% and 20% are not uncommon. Variability in humidity is the result

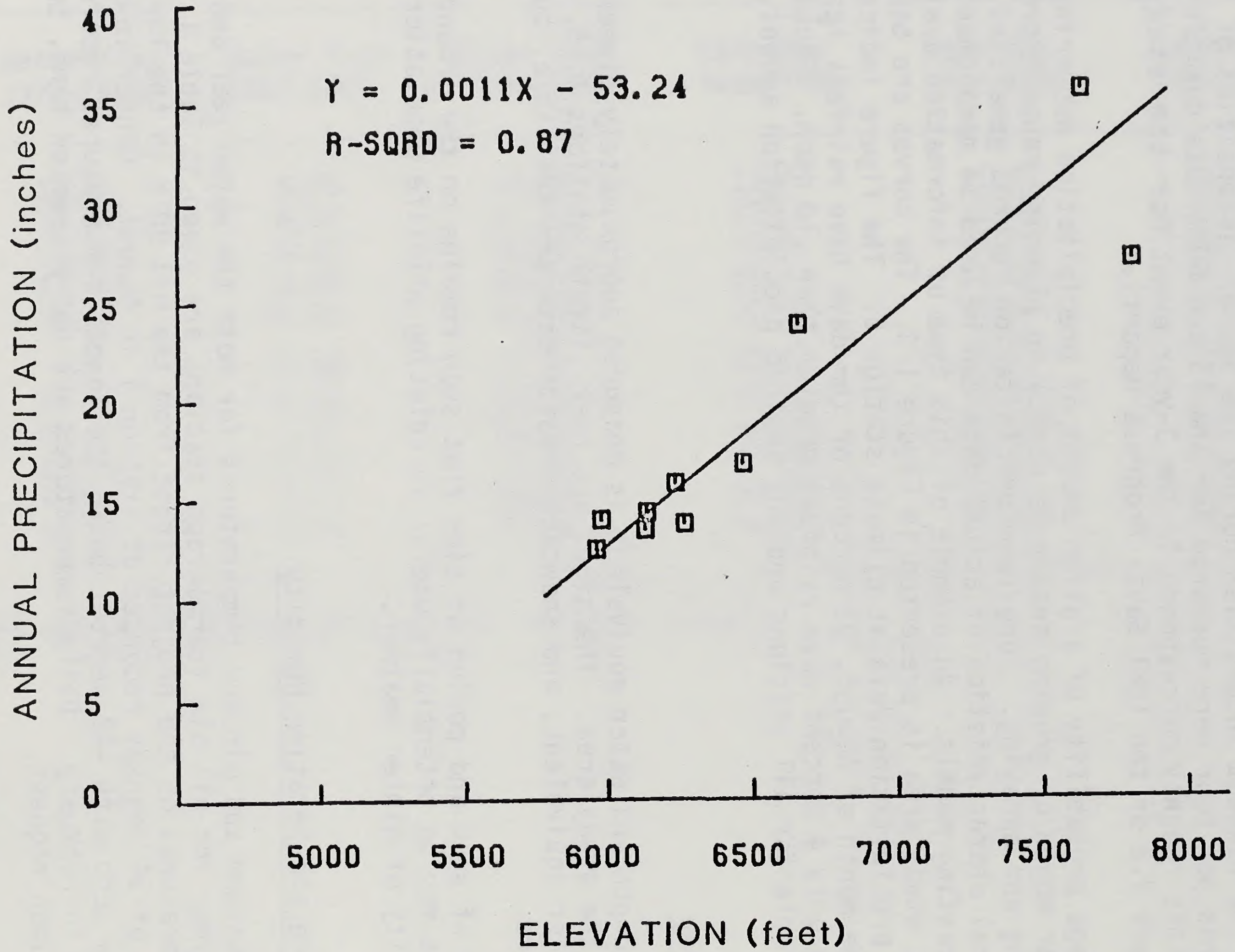


Figure 1.2. Regression of average annual precipitation as a function of elevation for 10 climate stations.

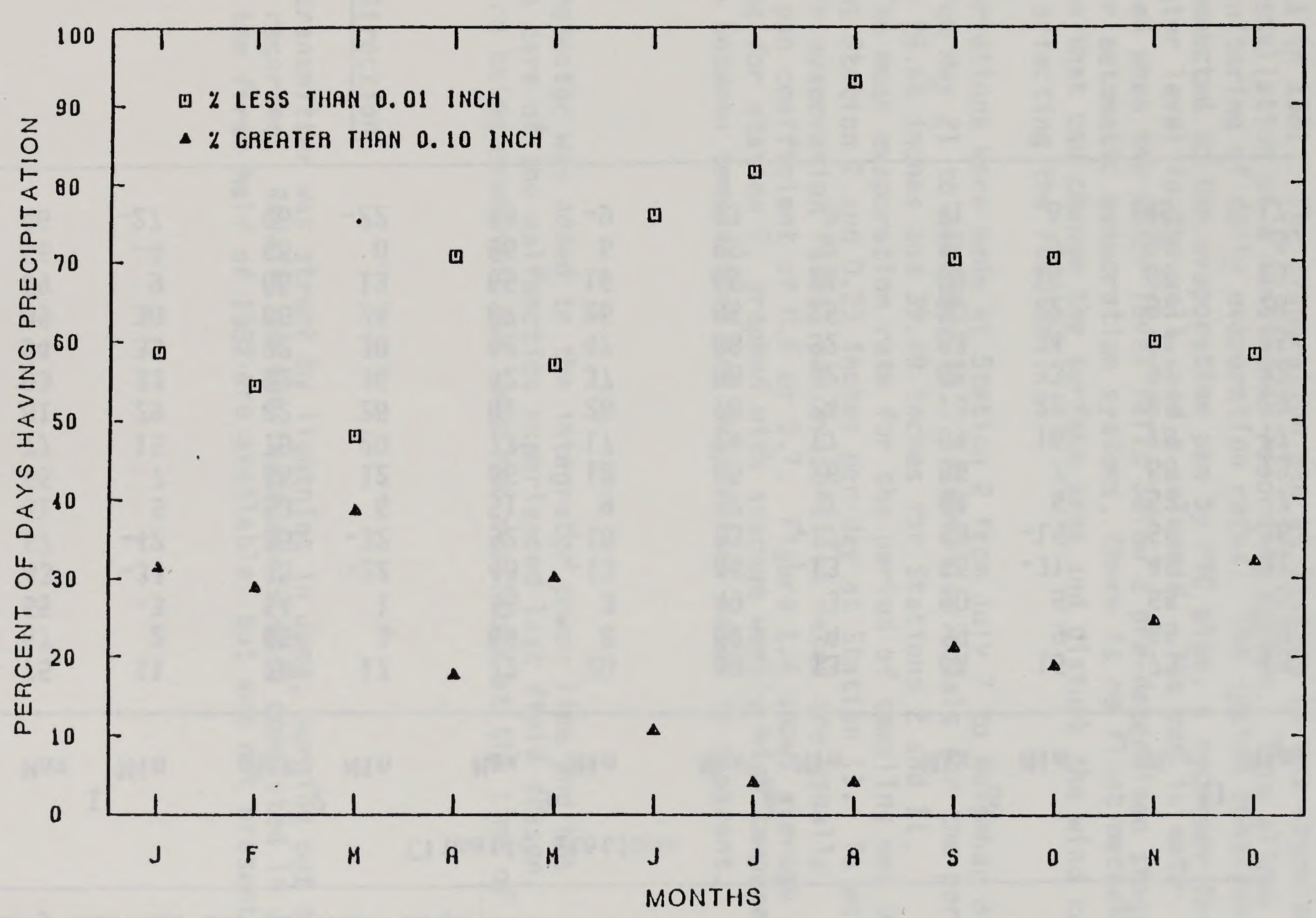


Figure 1.3. Percent of days having indicated precipitation amounts by month for climate station 5.

Table 1.3. Monthly maximum and minimum temperatures (°F).

Month	Climatic Stations 1 Max	1 Min	2 Max	2 Min	3 Max	3 Min	4 Max	4 Min	5 Max	5 Min	11 Max	11 Min
October 1981	75	11	79	17	72	20	69	13	64	15	73	13
November 1981	67	2	65	3	65	8	62	4	59	9	65	3
December 1981	55	-3	54	1	55	3	49	3	50	5	55	-1
January 1982	43	-34	43	-22	48	-13	46	-13	45	-31	45	-31
February 1982	57	-42	55	-32	52	-18	53	-17	49	-15	54	-36
March 1982	51	5	53	6	51	9	52	7	44	5	53	7
April 1982	66	7	66	12	66	12	65	6	56	7	68	13
May 1982	77	15	76	20	77	17	74	17	69	16	78	17
June 1982	81	29	82	26	81	26	78	24	73	22	83	29
July 1982	93	33	92	36	92	37	88	32	82	33	92	32
August 1982	94	35	92	38	92	42	88	32	83	34	94	35
September 1982	89	30	88	24	87	26	85	25	80	22	89	26
October 1982	69	9	65	13	65	16	65	14	59	16	68	13
November 1982	56	-4	56	0	56	5	55	2	51	7	56	-5
December 1982	46	-27	46	-22	48	-9	43	-8	41	5	45	-17

of localized storm events. Daily humidity values are available, but not presented here.

Evaporation

Standard National Weather Service Class A evaporation pans were installed at Stations 2 and 11 in 1981. The evaporation pan at Station 11 was upgraded this year with the installation of a continuous recording system. This allows for more detailed monitoring of daily evaporation rates. The system consists of a stilling well connected to the evaporation pan by PVC pipe, a recorder for measuring the water level in the well, and a solenoid. The pan is automatically refilled when the water level falls below a pre-determined stage. Unlike many other automatic evaporation systems, there is no float mechanism inside of the pan that can change the surface area and disturb the wind currents across the pan, affecting the results.

Evaporation observations were made at Station 2 from July 7 to November 8, and at Station 11 from May 21 to November 10. Evaporation totals for the periods of measurement were 25.68 inches and 39.99 inches for Stations 2 and 11, respectively. The mean evaporation rate for the period of sampling was 0.21 inches per day at Station 2 and 0.23 inches per day at Station 11. To estimate lake or reservoir evaporation rates, pan evaporation rates are usually multiplied by a pan coefficient of 0.6 or 0.7. Figure 1.4 shows average weekly evaporation rates for station 2, graphed with average weekly high temperatures. The relationship between temperature and evaporation rates is apparent.

Solar Radiation

A power surge protector was added to the integrator power line and has apparently taken care of the malfunction experienced last field season. The data collected are being examined, but were not available at the time of this report.

Wind Speed and Direction

The wind speed transmitter was struck by lightning in June, burning out the transmitter and recorder. Repairs on the instruments were completed in January 1983. Data for the first half of 1982 are available, but are not presented in this report.

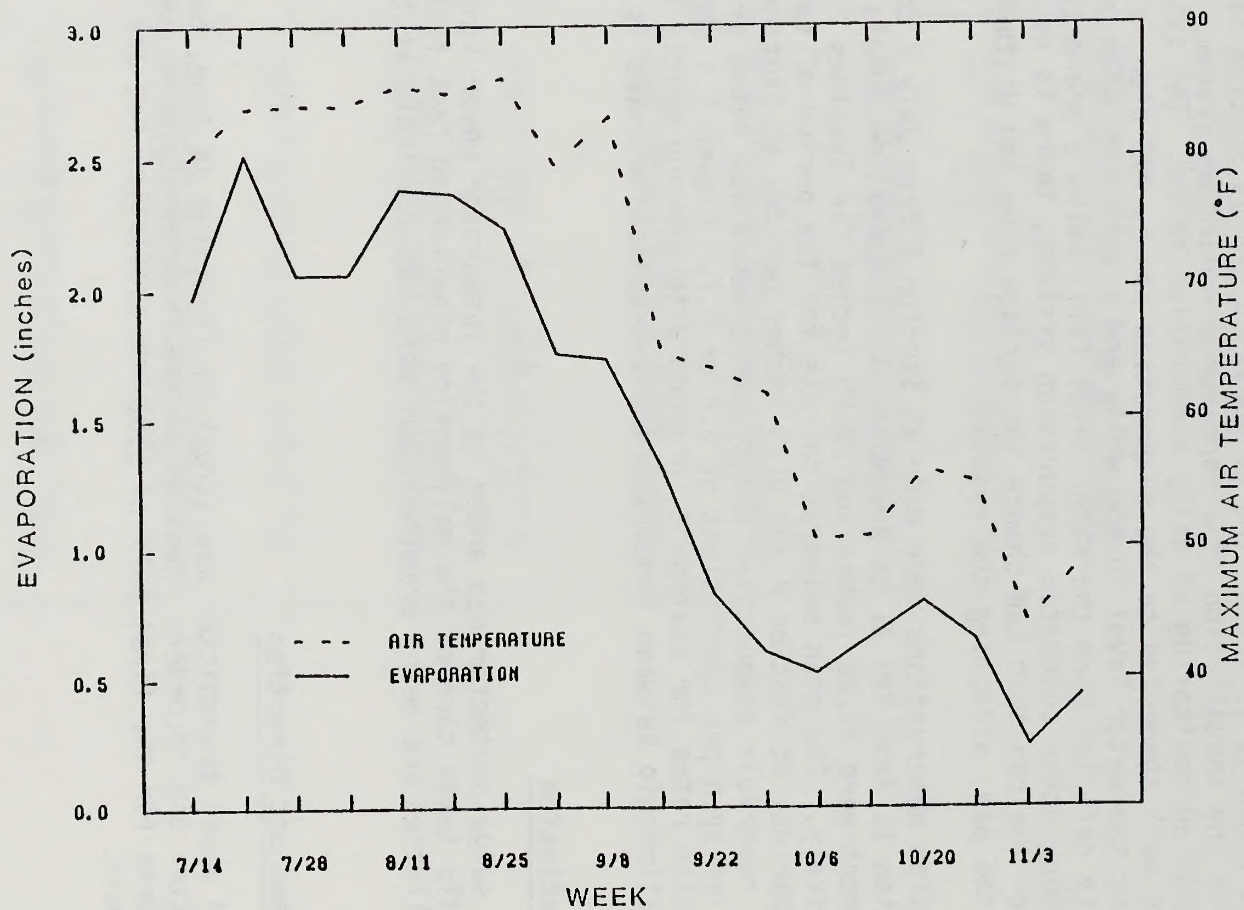


Figure 1.4. Weekly pan evaporation and average maximum air temperature at climate station 2 during 1982.

CHAPTER 2

VEGETATION RESEARCH

D. Waive Stager, Richard E. Eckert, Jr. and Russell T. Dailey

VEGETATION TREND

1982 Objectives:

1. Establish additional transects to estimate range condition and to monitor the trend in condition through species frequency and ground cover characteristics on various upland and riparian range sites.

2. Continue sampling for plant density and cover of tree and shrub species on new and previously established trend transects.

1982 Accomplishments:

In 1982, 28 additional transects were established: seven in meadow sites, four in the East Darling Seeding, two in the Lower Mahala pasture, five in the Upper Mahala pasture, eight in the Native Control pasture, and two in the North Forest Service pasture. The total number of trend plots is now 152:

5 in the East Darling Seeding
5 in the West Darling Seeding
6 in the Seeding Control Pasture
4 in the Tremewan Seeding
3 in the Lower Mahala Pasture
6 in the Middle Mahala Pasture
12 in the Upper Mahala Pasture
8 in the Native Control Pasture
3 in the Lower Sheep Creek Pasture
14 in the Upper Sheep Creek Pasture
24 in the South Forest Service Pasture
23 in the North Forest Service Pasture
39 in meadow sites

All of these transects have been sampled for species frequency and ground cover characteristics with the methodology described by Gordon Lymbery and R. E. Eckert in the 1979 Saval Progress Report and in the "Vegetation Sampling Procedure" section of the Saval Research and Evaluation Project Proposal.

Canopy cover and density of tree and shrub species were sampled in 1982 on all new transects and on transects in the Upper Sheep pasture. Canopy cover and density were sampled by methods described in the 1981 Saval Progress Report.

The Soil Conservation Service (SCS) visited most of the new non-meadow sites and verified their range site designations. The SCS has also provided a visual estimation of range condition for each new study site.

Seventy-six additional transects will be established before the grazing system starts in 1985:

1 in the Tremewan Seeding
3 in the Lower Mahala Pasture
6 in the Middle Mahala Pasture
7 in the Upper Mahala Pasture
11 in the Lower Sheep Creek Pasture
5 in the Upper Sheep Creek Pasture
17 in the South Forest Service Pasture
17 in the North Forest Service Pasture
9 in meadow sites

PRODUCTION

1982 Objective:

Measure production of herbaceous species on important range sites in crested wheatgrass pastures, BLM pastures, and USFS pastures during the 1982 growing season.

1982 Accomplishments:

In 1982, 23 areas representing 12 important range sites on the Saval Allotment were sampled periodically for herbaceous production (Tables 2.1 and 2.2). Data were collected by a double-sampling method with a nested group of five circular plots. Four sets of nested groups were sampled each period. Plot size was 10.8 ft^2 for upland sites and 1.1 ft^2 for meadows. Phenologic stages were recorded for each species. Herbage weight was estimated on three plots. On two plots herbage was clipped at ground level, bagged by species, and weighed. Clipped samples were air-dried and reweighed and these were used to correct estimated weights.

Plant growth was slow this spring due to cold temperatures in March and April. Production on the West Darling (WD) crested wheatgrass site was only 60 lb/ac on April 22 (Table 2.1) compared to 106 lb/ac on the same site by April 23, 1981 (1981 Progress Report). When temperatures warmed up, growth accelerated and production by the end of June this year was almost twice that of 1981 due to abundant and extended growing-season moisture. Seedings received more than twice the moisture from September 1981 thru June 1982 than during the same period of the previous year. Production on the WD site was 434 lb/ac this year at the end of June compared to only 231 lb/ac last year.

Highest production on seedings was 531 lb/ac on June 29 in the Control Darling (CD) pasture. Crested wheatgrass was in the "dough" stage and peak production had not been reached. Using the BLM phenology adjustment factor on CD data, peak production (seed-ripe) this year may have been about 775 lb/ac in early July. Last year, estimated peak production was 337 lb/ac.

Table 2.1. Herbaceous production on six range sites in BLM pastures on various dates during the 1982 growing season.

Range Site and Sampling Date	Pasture	Grasses	Forbs	Total
		Pounds/acre, air dry		
Crested Wheatgrass				
4-19	East Darling	39	1	40
4-22	West Darling	60	0	60
4-23	Control Darling	43	0	43
6-28	West Darling	432	2	434
6-29	East Darling	433	13	446
6-29	Control Darling	470	61	531
Loamy 8-10" p.z.				
4-23	Lower Mahala	39	13	52
5-12	Middle Mahala	113	76	189
6-24	Lower Mahala	90	121	211
6-28	Middle Mahala	142	121	263
Claypan 10-12" p.z.				
5-13	Middle Mahala	82	104	186
6-07	Upper Mahala	111	115	266
6-25	Middle Mahala	123	94	217
7-26	Upper Mahala	114	47	161
Loamy 10-12" p.z.				
5-19	Middle Mahala	96	193	289
6-03	Upper Mahala	128	95	223
6-30	Middle Mahala	187	132	319
7-23	Upper Mahala	84	117	201
Loamy Slope 10-14"				
6-02	Upper Mahala	142	79	221
7-21	Upper Mahala	100	44	144
Dry Meadow 10-16"				
6-01	Middle Mahala	185	76	261
6-02	Upper Mahala	522	76	598
6-30	Middle Mahala	515	261	776
7-22	Upper Mahala	1064	815	1879

Table 2.2. Herbaceous production on six range sites in USFS pastures on various dates during the 1982 growing season.

Range Site and Sampling Date	Pasture[1]	Grasses	Forbs	Total
		Pounds/acre, air dry		
Claypan 12-16"				
6-17	SFS	88	128	216
7-13	NFS	135	124	259
8-10	NFS	59	46	105
South Slope 12-14"				
6-08	SFS	236	170	406
7-21	NFS	491	47	538
8-03	NFS	794	1	795
Loamy Slope 14-18"				
6-10	SFS	125	881	1006
7-15	NFS	302	681	983
8-09	NFS	129	665	794
Dry Meadow				
6-17	SFS	548	330	878
7-12	NFS	2045	439	2484
8-05	NFS	446	153	599
Wet Meadow				
6-22	SFS	1422	652	2074
7-14	NFS	1977	468	2445
8-02	NFS	1956	559	2515
8-06	SFS	2270	509	2779
Aspen Woodland				
6-23	SFS	299	1411	1710
7-19	NFS	208	383	591
8-03	NFS	89	216	305

[1] SFS = South Forest Service
NFS = North Forest Service

The SVIM survey estimated production on these crested wheatgrass seedings at 826 lb/ac (adjusted to peak production at seed-ripe and a median-precipitation year). We feel this figure may be high. Last year was a below normal precipitation year while this year was an above normal year. Peak production in a median-precipitation year would probably be somewhere between our low of 337 lb/ac in 1981 and our high of 775 lb/ac this year.

Production on claypan and loamy range sites in Mahala pastures followed the same pattern as that of crested wheatgrass. Peak production occurred at least 2 weeks later this year than last year due to the colder spring temperatures. Also, the highest production sampled on these sites was about twice that sampled last year due to abundant and extended growing-season moisture.

Production difference between years was greatest on the Mahala Dry Meadow site. Peak production on this site may have been 2 months later this year than last. Production on a Dry Meadow range site is very dependent on the amount of water in intermittent streams. Stream flow was higher and continued longer this year than last. Highest production on the dry meadow sites this year was 2.5 times higher than last year.

Production on range sites in Forest Service pastures was also slowed by cold spring temperatures. In early June this year, production on the South Slope 12-14" pz Range Site was only 406 lb/ac (Table 2.2) compared to 684 lb/ac at the same time last year (1981 Progress Report). Peak production on Forest Service sites was also delayed. In 1981, peak production occurred in early July while this year it probably didn't occur until late July or early August. Production on most range sites in 1982 was greater than last year, but the increase was less than that on range sites in Mahala pastures.

Production on wet meadow sites declined this year in contrast to other range sites. Highest production sampled this year was 2779 lb/ac in early August while 1981 production was 3229 lb/ac. Soil on these meadow areas remained very wet throughout the growing season. This condition may have suppressed plant growth due to lack of oxygen and cold temperatures in saturated soil.

Peak grass production on Aspen Woodland sites probably occured in mid- to late-July this year. However, the highest production sampled was 1710 lb/ac on June 23. Mule's ear wyethia, an early growing invader species, accounted for 70% of this production. This is an indication of poor range condition of this site.

Cattle grazing of these range sites in relation to phenology throughout the growing season will be discussed in the following section of this report.

UTILIZATION

1982 Objective:

Estimate species utilization on major range sites at the end of respective grazing periods.

1982 Accomplishemnts:

The "Key Forage Plant Method" was used to estimate forage utilization on various range sites. Utilization was estimated at the end of a grazing period on all trend plots on sample areas of different range sites. These estimates were used to identify cattle preferences among range sites, changes in species and range site preferences over the grazing season, and differences in species and range site preferences between 1981 and 1982.

Cows grazed the East Darling (ED) pasture from April 16 to May 6. They were allowed to drift into the West Darling (WD) pasture on May 1. All cows were moved into the WD by May 6 where they grazed until about May 10. Use in both pastures was severe (81-100%) at the end of the grazing period (Table 2.3). Crested wheatgrass in the early leaf stage was the primary grazed species.

Spring was very cold in 1982 and plant growth was slow during the entire grazing period on crested wheatgrass seedings. When cows entered the ED, only 39 lb/ac of forage was available (Table 2.1). By comparison, on April 23, 1981 106 lb/ac of crested wheatgrass forage had been produced (1981 Saval Progress Report). Severe utilization in 1982 was due to the small amounts of forage available during the grazing period.

Weather warmed up after cows were moved to the BLM native range and, with abundant available soil moisture, regrowth on both Darling pastures was excellent. By July, these pastures showed no sign of the early spring grazing.

The Lower Mahala (LM) and Middle Mahala (MM) pastures were grazed from May 7 to May 25. Use was light (21-40%) to moderate (41-60%) on most range sites (Table 2.3). Sandberg bluegrass, a common species in these pastures, was the most preferred upland grass and received moderate use (Table 2.4). Webber ricegrass and Thurber needlegrass are less common but were also preferred at this time. Nevada bluegrass on the wet meadows also received moderate use, but make up only a small part of the cattle's diet since very few meadows occur in the LM and MM pastures.

Sandberg bluegrass is one of the earliest developing grasses on the Saval Allotment and reached the flowering stage while cows were in the Mahala pastures. Ricegrass and needlegrass are also early growing species but only reached the prebloom stage during this time. Nevada bluegrass was in early leaf during the grazing period.

Table 2.3. Vegetation utilization by cattle on range sites on the Saval Ranch pastures for the 1982 grazing season.

Range Site	East Darling	West Darling	Lower Mahala	Middle Mahala	Upper Sheep	South Forest	North Forest
	(4-16 to 5-6)[1]	(5-1 to 5-10)	(5-7 to 5-24)	(5-11 to 5-25)	(5-25 to 6-24)	(6-24 to 8-1)	(7-29 to 9-30)
Crested wheat seeding	5[2]	5-	-	-	-	-	-
Loamy 8-10"	-	-	2-	2	3	-	-
Claypan 10-12"	-	-	2+	2+	3-	-	-
Loamy 10-12"	-	-	3	3-	3-	-	-
Loamy Slope 10-14"	-	-	-	-	3-	3	2+
Loamy Bottom	-	-	1+	-	3-	3	2+
Claypan 12-16"	-	-	-	-	2-	1-	1
Wet Meadow	-	5	-	3	3	5	4-
Dry Meadow	-	-	-	-	-	4+	3
South Slope 12-14"	-	-	-	-	-	3	2
South Slope 14-18"	-	-	-	-	-	4-	2+
Loamy Slope 14-18"	-	-	-	-	-	2	2
Steep North Slope 14-18"	-	-	-	-	-	0	1
Aspen Woodland	-	-	-	-	-	3	2
Aspen Thicket	-	-	-	-	-	-	1-
Mt. Ridge	-	-	-	-	-	2	1
Snowbank	-	-	-	-	-	2-	-

[1] Grazing period

[2] Utilization classes

0 = No Use = 0%
1 = Slight = 1-20%
2 = Light = 21-40%
3 = Moderate = 41-60%
4 = Heavy = 61-80%
5 = Severe = 81-100%
+ or - indicates use was at the high or low end of a class

Table 2.4. Utilization by cattle of common species on the Saval Ranch pasture for the 1982 grazing season.

Species	East Darling (4-16 to 5-6)[1]	West Darling (5-1 to 5-10)	Lower Mahala (5-7 to 5-24)	Middle Mahala (5-11 to 5-25)	Upper Sheep (5-25 to 6-24)	South Forest (6-24 to 8-1)	North Forest (7-29 to 9-30)
Crested wheatgrass	5[2]	5-	-	-	-	-	-
Sandberg bluegrass	-	-	3	3	3+	0	1-
Bottlebrush squirreltail	-	-	1+	2-	2	0	0
Thurber's needlegrass	-	-	2	3	2+	0	0
Webber ricegrass	-	-	2	3-	2	-	-
Great Basin wildrye	-	-	1-	0	2	3	2
Bluebunch wheatgrass	-	-	-	2+	2	3-	2-
Spike fescue	-	-	-	-	4	3	4-
Idaho fescue	-	-	-	-	2	2-	2+
Needlegrass sp.	-	-	-	-	-	2-	1-
Mountain brome	-	-	-	-	-	1+	1-
Nevada and Kentucky bluegrass	-	-	-	4	3+	4+	4-
Meadow grasses	-	-	-	-	2	3+	2-
Sedges	-	-	1-	1	2	3+	3-
Rushes	-	-	-	2	2	3+	4-
Antelope bitterbrush	-	-	-	-	0	4-	1+

1 Grazing period

2 See Table 2.3 for key to utilization classes

Grazing during the period when bluegrass, ricegrass, and needlegrass are in the early leaf to bloom stages is beneficial to cattle but detrimental to plants. When plants are approaching the bloom stage, they are productive and ideally balanced in minerals, vitamins, proteins, carbohydrates, roughage and moisture for livestock gain. However, grazing can be harmful to plants when carbohydrate reserves are at a minimum. This occurs about the time flower stalks are showing. Detrimental effects of grazing at this time can be minimized. For example, the Saval management plan was designed to minimize the harmful effects of spring use through a stocking rate to achieve moderate utilization during the grazing period and timing of grazing to allow for regrowth after cows are removed.

From May 25 to June 24, cattle grazed the Upper Sheep Creek (USC) pasture. Use was moderate on all sites except the Claypan 12-16" Range Site which received light use (Table 2.3). Last year the Claypan site was also the least preferred.

Nevada bluegrass received moderate use (Table 2.4) in wet meadows that contain only a very small portion of this pasture's forage. Other meadow species received light use. Sandberg bluegrass, a common species in this pasture, was still preferred during this grazing period. Spike fescue, an infrequent species, received heavy use (61-80%). Thurber needlegrass and Webber ricegrass received light use, as did bottlebrush squirreltail, Great Basin wildrye, bluebunch wheatgrass, and Idaho fescue. These species all provided good nutrition for cattle during this grazing period since they were in prebloom to dough stages. Grazing can be harmful to the plant when carbohydrate reserves are at a minimum during these growth stages. Regrowth this late in the season is unlikely in most years. However, the management plan provides for complete rest in the year following the late spring grazing treatment.

In 1981, Thurber needlegrass and Webber ricegrass were preferred over Sandberg bluegrass. Spring was drier and warmer last year so the bluegrass probably matured sooner and was less palatable to cattle. Needlegrass and ricegrass mature slightly later than bluegrass and were probably still palatable when cows grazed the pasture in 1981.

In late June cows were moved from the USC pasture to the South Forest Service (SFS) pasture. Starting in late July and continuing thru August, most of the herd was moved into the North Forest Service (NFS) pasture where they grazed until the end of September.

Use on the Wet Meadow, Dry Meadow and many of the Aspen Woodland Range Sites was heavy to severe in the SFS (Table 2.4). The South Slope 14-18", South Slope 12-14", and Loamy Slope 10-14" Range Sites were also preferred in the SFS and received moderate to heavy use. Use was moderate to heavy on meadow sites in the NFS. Some of the Aspen Woodland sites received severe use but many received light use. Use on the Loamy Slope 10-14" and two South Slope Range Sites was light.

Over the past 3 years utilization on range sites in the early summer-use pasture was higher than on the same range sites in the late summer-use

pasture. Last year, in the NFS pasture (early spring grazing), the California Creek area received even heavier than normal use due to the shortage of water (1981 Saval Progress Report). This year during late summer use, very few cows grazed this drainage until early September. On many California Creek meadows much of this year's forage was left ungrazed, either standing or knocked down. Use on other range sites in this drainage was also much lighter in 1982 than in 1981. The area was abused in 1981, but has recovered well this year due to the late grazing period, good growing season, and moderate utilization.

Heavily used preferred species, in the SFS were meadow bluegrasses (Kentucky and Nevada) and antelope bitterbrush (Table 2.4). Other preferred species during the same period were Great Basin wildrye, bluebunch wheatgrass, spike fescue, sedges, rushes, and various meadow grasses. Most grasses in the SFS were in prebloom or bloom stages when cattle were turned in, and either reached seed-ripe or shed their seeds by the end of the early summer grazing period. As for the BLM pastures, the management plan attempts to mitigate any negative effects of grazing when carbohydrate levels are low. In the FS pastures, negative effects are reduced because plants grazed during a critical growth stage in one year are deferred until seed ripe the following year. This practice is probably more effective on upland species that receive moderate use than on the wet meadow species that receive heavy to severe use.

Use on most of the above species in the NFS was about the same or lower than in the SFS. However, use on spike fescue was higher than in the SFS, while use on antelope bitterbrush was much lower. Spike fescue seems to be very palatable to cattle even after seed is cast and forage is dry. Other grasses seem to be less palatable after seeds are cast.

Heavy use on bitterbrush during early summer on the SFS may be a reflection of high utilization of preferred herbaceous species that resulted in earlier than expected switch to bitterbrush. Usually cattle increase their use of bitterbrush late in the season as grasses mature and quality declines. Low use on bitterbrush in late summer pasture (NFS) was unexpected.

Cattle probably maintained a high level of nutrition while grazing the early use (SFS) pasture. However, level of nutrition in the late-use pasture (NFS) was probably much lower since most forage species had matured before cattle grazed the pasture. The ranch manager, Ralph Vance, commented in September that cattle had "fallen off", meaning they had lost weight and did not appear as healthy as in the early-use pasture.

1982 Objectives:

1. Determine percent stocking for various species seeded in 1981.

2. Use these data to rate seeding success on sample sites and over the entire seeded area.

1982 Accomplishments:

In July success of the Lower Sheep Creek seeding was evaluated. Sample sites were selected at one-quarter mile intervals on roads through the seeding (Figure 2.1). The procedure used was similar to that described by Hyder and Sneva (1954). A 2 x 5 ft sampling frame was used to determine presence or absence of seeded species at prescribed intervals over a paced transect. The grid contained 10, 1 ft^2 subplots. At each sample site, the grid was moved four times so that 40, 1 ft^2 subplots were sampled. The frequency of occurrence (% stocked) for each species seeded was recorded.

Data were tabulated and a success rating was assigned to each site sampled. The success-rating scale presented below from Hyder and Sneva (1954) appears suitable for areas of 10-12 inches annual precipitation. This would include the Lower Sheep Creek seeding. At 50% stocked, a stand would have, on the average, at least one plant/2 ft^2. At 25% stocked, a stand would have, on the average, at least one plant/4 ft^2.

Success Rating	Percentage Stocked
Excellent	50% or more
Good	40-49%
Fair	25-39%
Poor	10-24%
Failure	9% or less

Percent stocked and success rating for each sample site are presented in Table 2.5 for two species, Nordan crested wheatgrass and pubescent wheatgrass. Ratings are based on percent stocked values for crested wheatgrass only. This was done because crested wheatgrass is the most adapted species and the one that will dominate the stand in time. Stands of Russian wildrye, sweetclover, alfalfa, and burnet were rated as failures. Although stands of forbs were very sparse (0-5% stocked), density of established plants may be sufficient to supply some food for wildlife.

The overall success estimate by area is shown in Figure 2.1. This was an ocular estimate and may differ from conditions present at specific sample sites. Unfavorable aspects and soil types may have resulted in sample sites appearing to be less successful than for the stand as a whole. In addition, sites rated poor may comprise only a small portion of a larger area. Overall, success of the 2430 acre seeding is fair. Approximate acreages for each success-rating category are as follows: Excellent, 220; Good, 430; Fair, 1530; and Poor/Failure, 250.

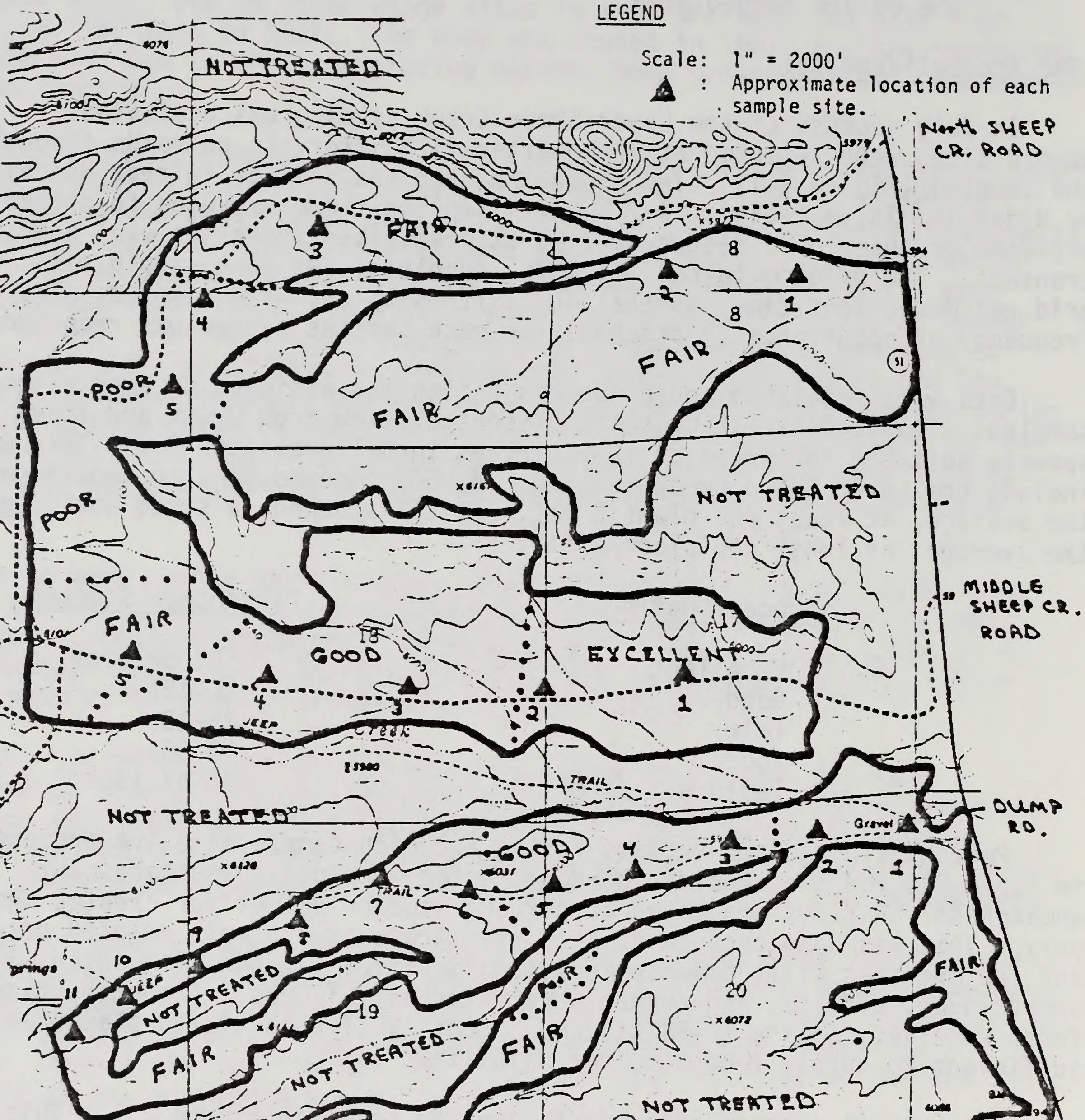


Figure 2.1. Lower Sheep Creek Seeding. Estimate of seeding success is shown in each delineation. Approximate division between areas of different success is shown by a dotted line.

Table 2.5. Results of sampling the Lower Sheep Creek Seeding.

Location and Stop	% Stocked (Frequency) Crested wheatgrass	Pubescent wheatgrass	Rating
Middle Sheep Creek Road			
1. North side	76	43	Excellent
South side	41	15	Good
2. North side	38	15	Fair
South side	41	13	Good
3. North side	47	22	Good
South side	42	16	Good
Steep slopes	12	3	Poor
4. North side	24	10	Poor
South side	51	25	Excellent
5. North side	18	2	Poor
South side	49	26	Good
Clay pan	2	0	Failure
North Sheep Creek Road			
1. Loamy 8-10"	44	15	Good
2. Loamy 8-10"	38	11	Fair
3. Loamy bottom	24	4	Poor
Ridge top	15	2	Poor
North slope	16	4	Fair
4. North slope & clay pan	11	1	Poor
South Slope	45	11	Good
North slope & ridge top	14	3	Poor
5. Ridge top	8	2	Failure
Clay pan	11	11	Poor
Dump Road			
1. Loamy bottom	31	4	Fair
2. Loamy bottom	39	21	Fair
North slope	4	4	Failure
South slope	22	11	Poor
3. South slope	22	8	Poor
North slope	4	3	Failure

Table 2.5. Continued

Location and Stop		% Stocked (Frequency) Crested wheatgrass	Pubescent wheatgrass	Rating
4.	South slope	20	12	Poor
	North slope	5	3	Failure
5.	South slope	16	8	Poor
6.	South slope	15	7	Poor
	North slope	17	11	Poor
7.	South Slope	20	15	Poor
	Loamy bottom	13	10	Poor
	North slope	8	5	Failure
8.	Loamy bottom	33	18	Fair
	Clay pan	5	1	Failure
	Loamy bottom	23	14	Poor
9.	Loamy bottom	17	8	Poor
	North slope	23	11	Poor
10.	Loamy bottom	25	14	Fair
	North slope	28	14	Fair
	North slope	27	18	Fair
11.	South slope	26	19	Fair

Literature Cited

Hyder, Donald N. and Forrest A. Sneva. 1954. A method for rating the success of range seeding. J. Range Management. 7:89-90.

CHAPTER 3

SAGE GROUSE RESEARCH

Mack R. Barrington and Gary N. Back

POPULATION DYNAMICS

1982 Objective:

Monitor sage grouse population levels.

1982 Accomplishments:

Population dynamics were monitored through strutting ground counts and hunter harvest data. Strutting ground counts were conducted from 21 March through 25 April, 1982 using the Patterson census technique (Patterson 1952). An attempt was made to count all grounds, however, access to all grounds in a single morning was not always possible. In addition, the number of observers per count day varied, limiting the number of grounds that could be visited. Counts were conducted between sunrise and 0900.

The maximum number of cocks observed on strutting grounds in a single count was 107. Based on a 40:60 male:female ratio (Beck 1977, and from Nevada Department of Wildlife (NDOW)), the estimated total population for 1982 was 268. This estimate represents a 32% decrease from 1981 and a 60% decline from 1979.

Although the validity of the Patterson census technique has been tested (Jenni and Hartzler 1978), its use depends on knowing the time of peak breeding or else censusing frequently enough during the strutting season to cover the post-peak period of female attendance. The five complete counts conducted in 1982 may have been insufficient to cover this period. In addition, day to day attendance at the grounds was highly variable; the mean count for the five censuses was 90 males with a range of 62-107. If the counts were not obtained during the period of greatest male attendance or on days with low attendance during the peak period, a population estimate based on the "maximum" count would underestimate the true population size.

The strutting ground counts should be conducted more intensively in future years if reliable population estimates are to be obtained. Both the number of counts and the number of observers should be increased to ensure adequate coverage. Use of colored leg bands to identify individual males would provide information on the extent of interground movements and on the reliability of combining counts made on different days from different strutting grounds.

Hunter harvest data was collected in a cooperative effort with NDOW. A check station was operated 11-12 September, 1982 on the Mountain City Highway. Data collected from those who hunted on the Saval Project area included: number of hunters, number of hunter days, and number of birds bagged. Biological data included: sex of each bird and collection of a wing for age and molt pattern determination.

The harvest data for the Saval Ranch and the region indicated a poor grouse production year. The ratio of juveniles to females was 0.3:1 and based on wing molt patterns, 75% of the adult and yearling females were not successful in producing broods. Dalke et al. (1963) found that a mean minimum temperature of 34.8^{o}F and 1.57 inches of precipitation during the

period 15 May - 1 June resulted in lower juvenile survival in Idaho. Both 1980 and 1981 were considered poor production years due to cool, wet weather. The temperature data collected on the Saval Ranch (J. Barber, personal communication) indicated temperatures during the peak of hatching in 1982 were similar to 1980 and 1981. Mean minimum temperatures for May and June were 32.7, 36.9°F; 30.6, 39.6°F; and 31.9, 41.2°F (1980, 1981, and 1982, respectively). Precipitation totals for the period 10 May - 23 June were 1.91, 1.45, and 2.37 inches (1980, 1981, and 1982, respectively). Poor production combined with fewer birds in the breeding population appear to be the major factors in the downward trend of sage grouse numbers.

The harvest data from Saval Ranch are subject to the vagaries of small sample data sets. However, the data have had the same tendencies as the regional sample collected by NDOW, and therefore, appear to be representative of the sampled population. But preliminary data from the telemetry work (also based on small samples)indicate that males, females with broods, and broodless hens occur in segregated groups and differ in summer-early fall habitat selection. This raises the possibility of harvest data being biased if hunters have tendencies to hunt by habitat type. Telemetry efforts should be continued to provide a basis for evaluating this question.

HABITAT UTILIZATION

1982 Objective:

Document vegetation characteristics of habitats used by sage grouse for seasonal activities.

1982 Accomplishments:

The vegetation on 68 sage grouse use sites was sampled in 1982. The majority of these sites were determined by telemetry procedures (see MOVEMENTS AND DISTRIBUTION). Ten of the sampled sites were nest location, 12 were brood rearing sites, and 46 were feeding-loafing sites.

As part of the telemetry work the general habitat types were noted at the time of the observation. The three dominant plant species were used to classify general vegetation types. At each site a square macroplot (210 ft^2) was established. Ten shrubs were randomly selected for measurement of height and crown diameter within the plot. The shrub at nest sites was also measured for height from ground to foliage. Within the macroplot, 25 microplots (387 in^2) were established at 39 inch intervals around the site (see 1980 progress report for a diagram of plot layout). At each microplot species frequency, canopy cover (%) by species, and ground cover were recorded.

Nest Sites

Most nest sites were found in heterogeneous vegetation types both in structure and composition. Small to medium (less than 1 acre) islands of big sagebrush within larger areas of early sagebrush were most often used for nesting sites. Nests were usually located toward the edge of these islands. This has been the observed trend for 31 nest sites sampled in the

past three years. Nests were also found more often on upper portions of moderately sloping ridges. No preference was observed for any particular slope-aspect combination.

Vegetation data on these sites showed little change from 1981 in number of plant species present. Mean canopy cover of forbs, grasses, and shrubs at nest sites were also comparable to 1981 sites at 3, 7, and 25%, respectively. Of the 38 forb species found at nest sites, Hoods phlox, crag aster, little flower collinsia, and navarretia were the most common. Bottlebrush squirreltail and Sandberg bluegrass were the most frequent of the 10 grass species found. Five shrub species were found at nest sites with Wyoming big sagebrush, little rabbitbrush, and early sagebrush being most common.

Wyoming big sagebrush was found over five of the ten nests located. Antelope bitterbrush was found over four nest sites and one nest was found under early sagebrush. Wyoming big sagebrush and antelope bitterbrush were almost identical in their height and crown diameter measurements (Table 3.1). However, bitterbrush produces a canopy that grows closer to the ground.

Table 3.1. Shrub characteristics at sage grouse nest sites.

Species	Mean Height (in.)	Mean Crown Diameter (in.)	Mean Ground to Shrub (in.)
Wyoming big sagebrush	30	37	9
Antelope bitterbrush	29	37	7
Early sagebrush	16	22	6
Little rabbitbrush	14	18	-

Research on sage grouse nest sites in other areas has found shrub cover to range from 18 to 27% (Klebenow 1969, Wallestad and Pyrah 1974, Peterson 1980). Our data indicate a similar situation on the Saval. The herbaceous cover was also similar to values found in the other studies.

Brood-Rearing Sites

Preciptation levels were higher in 1982 than in the previous two years. As a result, brood movement was observed to be much slower away from nesting habitats. Upland sites were heavily used even into mid-summer. Most of these sites were level ridge tops dominated by islands of Wyoming big sagebrush within larger areas of early sagebrush.

Riparian areas were utilized more heavily in late summer when stringer meadows with large amounts of shrub cover along the margins received greater use. Movements from upland types to riparian sites and back to upland types were observed throughout the summer. This movement pattern is more typical of males or broodless females.

Seventy forb species, accounting for 5% canopy coverage, were observed

on brood-rearing areas. Long leaf phlox, little flower collinsia, poverty sumpweed, western yarrow, and western aster were the most common forb species. Grasses accounted for 15% of the canopy coverage. Bottlebrush squirreltail, Sandberg bluegrass, and mat muhly were the most common of the 21 grass species observed on these sites.

Forb coverage on these sites seemed rather low when compared to other studies. Martin (1970), Peterson (1970), and Wallestad (1971) found that forb coverage was 22 - 33% on brood areas. The difference may be due to the activity sites sampled. Schoenberg (1982) found 7% forb coverage in feeding-loafing sites and 41% coverage at sites used only for feeding. Our samples may have been primarily of feeding-loafing areas used after the early morning feeding was completed.

Shrub coverage at brood-rearing sites was 12%. Wyoming big sagebrush, little rabbitbrush, early sagebrush, and basin big sagebrush were the most frequent shrub species on these sites. Wyoming big sagebrush, early sagebrush, and little rabbitbrush are species common to many habitats throughout the study area. Therefore, their high frequency was expected on these sites. However, basin big sagebrush, rubber rabbitbrush, and antelope bitterbrush are more site specific. Basin big sagebrush and rubber rabbitbrush are primarily drainage species, whereas bitterbrush is an upland, high elevation species. Presence of all three species at brood sites (Table 3.2) indicates the variety of sites used by broods.

Table 3.2. Shrub characteristics on sage grouse brood sites.

Species	Mean Height (in.)	Mean Crown Diameter (in.)
Wyoming big sagebrush	30	29
Early sagebrush	13	18
Little rabbitbrush	12	13
Basin big sagebrush	38	29
Rubber rabbitbrush	42	31
Antelope bitterbrush	25	23
Others (4 species)	49	40

Adult Feeding-Loafing Sites

Adult sage grouse, both females without broods and males, seemed to persist on upland types from spring to fall during 1982. We assume much of this apparent preference was due to increased moisture on these sites. Increased precipitation reduced the dependence on riparian types for succulent plants. The habitats used by adult birds were the same mosaic types described in the previous sections. Ecotonal areas between early sagebrush types and Wyoming big sagebrush types were heavily used. No significant differences were observed in plant canopy coverage between 1981 and 1982. Canopy coverage of forbs, grasses, and shrubs was 12, 8, and 23%, respectively.

Little flower collinsia, poverty sumpweed, crag aster, western yarrow, and buckwheat were the most common of the 83 forb species found. Twenty grass species were encountered on feeding-loafing sites. Bottlebrush squirreltail, Sandberg bluegrass, Thurber's needlegrass, and mat muhly were the most common grass species. Little rabbitbrush was the most frequent shrub species of the 14 shrubs found on these sites. However, this species is a common component of most habitat types on the study area. Other upland species that were common at feeding-loafing sites included Wyoming big sagebrush, early sagebrush, and antelope bitterbrush. Some use of moist draws and drainages was indicated by the presence of basin big sagebrush. Shrub characteristics of adult feeding-loafing sites are given in Table 3.3.

Table 3.3. Shrub characteristics of sage grouse feeding-loafing sites.

Species	Mean Height (in.)	Mean Crown Diameter (in.)
Little rabbitbrush	14	15
Wyoming big sagebrush	32	31
Early sagebrush	14	16
Basin big sagebrush	46	28
Antelope bitterbrush	30	29
Others (7 species)	37	48

Twenty-three percent shrub cover on these sites was comparable with data from other studies. Martin (1970). working in Montana found that habitats used by sage grouse in summer were characterized by 25% shrub cover. Similar findings have been reported by Wallestad and Schladweiler (1974) for male sage grouse in Montana.

HABITAT AVAILABILITY

1982 Objective:

Continue mapping vegetation types to determine the cover types and the extent of habitats available for sage grouse use.

1982 Accomplishments:

Field mapping was done on mylar covered 1:7,290 black and white aerial photography. Color-infrared photography (1:24,000) was used as an aid in delineating riparian and upland browse types. Types were classified by the dominant plant species method. This method usually included two overstory species (shrubs) and one understory species (grasses). A general description of the cover types was obtained by sampling selected sites with the vegetation sampling methods described in the HABITAT UTILIZATION section. The use of this system facilitates comparisons between measurements of habitats used by sage grouse and what is available for their use.

Vegetation mapping was started in Lower Sheep Creek Pasture during 1981,

preceding the plowing and seeding of 2,400 acres of the pasture. The mapping process has been expanded since to include other areas of the ranch. Field mapping has been completed in Lower Sheep, Upper Sheep, Lower Mahala, Middle Mahala, and Upper Mahala pastures. We have identified 38 different vegetation types within this 20,000 acre area. These types have been mapped to a 2-acre resolution.

The purpose of the vegetation mapping was to document the distribution and acreage of vegetation types on the Saval Project area. By determining habitat availability, we can compare habitats used to habitat availability and statistically determine habitat preferences. Further, we can measure changes in habitat preferences, if any, that result from implementation of the grazing system or other range improvements.

The completed mapping project will be used to establish a stratified sampling scheme for quantifying variations of the vegetation characteristics within each cover type. A data storage and retrieval system will be developed for both tabular and spatial comparisons and to make the data readily available to personnel of the other disciplines.

MOVEMENTS AND DISTRIBUTION

1982 Objective:

Determine movement and distribution patterns of sage grouse by age and sex group.

1982 Accomplishments:

Movements and distribution were determined primarily through trapping and telemetry operations. Birds were netted using the nightlighting technique or trapped with wing nets placed in stringer meadows. All captured birds were leg banded and females were fitted with radio transmitters. Locations of radio-equipped birds were plotted on maps for later determination of home ranges and distances of movements. Home ranges were defined as the area enclosed by a polygon of the outermost locations for each bird. Average weekly movements were based on distances between successive locations made 4 - 10 days apart.

Eleven birds were captured in 1982; seven females and four males. Four of the seven females were eventually killed by predators and the radios were recovered. The remaining three females were tracked until the radio batteries expired in December 1982. Attempts to recapture the birds to replace the radios were unsuccessful.

Home ranges for the females are given in Table 3.4 and plotted in Figure 3.1. Female 16-301 had the smallest home range of all birds that were radio-tracked for more than four months and was the only female that raised a brood. The acutal area used by each bird was much less than the calculated home range as the birds tended to use specific habitats, slopes, and aspects rather than the entire area within their home ranges (see HABITAT UTILIZATION).

The mean weekly movement of birds 16-301, 16-303, 16-333, and 16-337 was 2,600 ft. (S.D. = 650 ft.). Hen 16-301 (with brood) had the lowest mean

weekly movement (1,900 ft.). Since the birds were usually flushed at the time of observation, which influenced their movements, no attempt was made to locate the birds on successive days to determine daily movements. The typical pattern of movement was for the birds to use an area for up to a week and then move to another area. Birds often returned to areas they had used several weeks earlier.

The small sample size limits the conclusions that can be made from the 1982 data. However, the 1982 telemetry work has raised several questions to be answered and hypotheses to be tested in the next few years.

1. What are the daily movement and habitat use patterns of cocks, hens with broods, and hens without broods?
2. Are sage grouse daily movement and habitat use patterns influenced by the presence of cattle?
3. What influence does spring-summer precipitation have on grouse distribution and habitat use?
4. Hypothesis: Hens with broods use the same habitats as hens without broods (or males).
5. Hypothesis: The home range of hens with broods is the same size as the home range of hens without broods.

In addition, a winter distribution and habitat use study was proposed to begin winter 1982-83. The study is designed to identify winter habitats used for different activities, climatic factors that influence habitat use, and quantify habitat prameters that can be used to identify potential wintering areas.

Table 3.4. Home range estimates and period of radio contact for radio-collared sage grouse.

Bird No.	Date Trapped	Date of Final Record	Calculated Home Range (acres)
16-301	4/22/82 N[1]	10/13/82 M[2]	459
16-303	4/22/82 N	12/01/82	1,760
16-313	8/06/82 W	9/21/82 M	**
16-314	8/04/82 W	10/21/82 M	**
16-333	4/23/82 N	11/17/82	1,174
16-337	4/26/82 N	11/29/82	1,205
16-340	4/26/82 N	8/27/82 M	**

[1]N = nightlighting technique; W = wing nets.

[2]M = mortality by predation.

** = Insufficient locations obtained to determine home range.

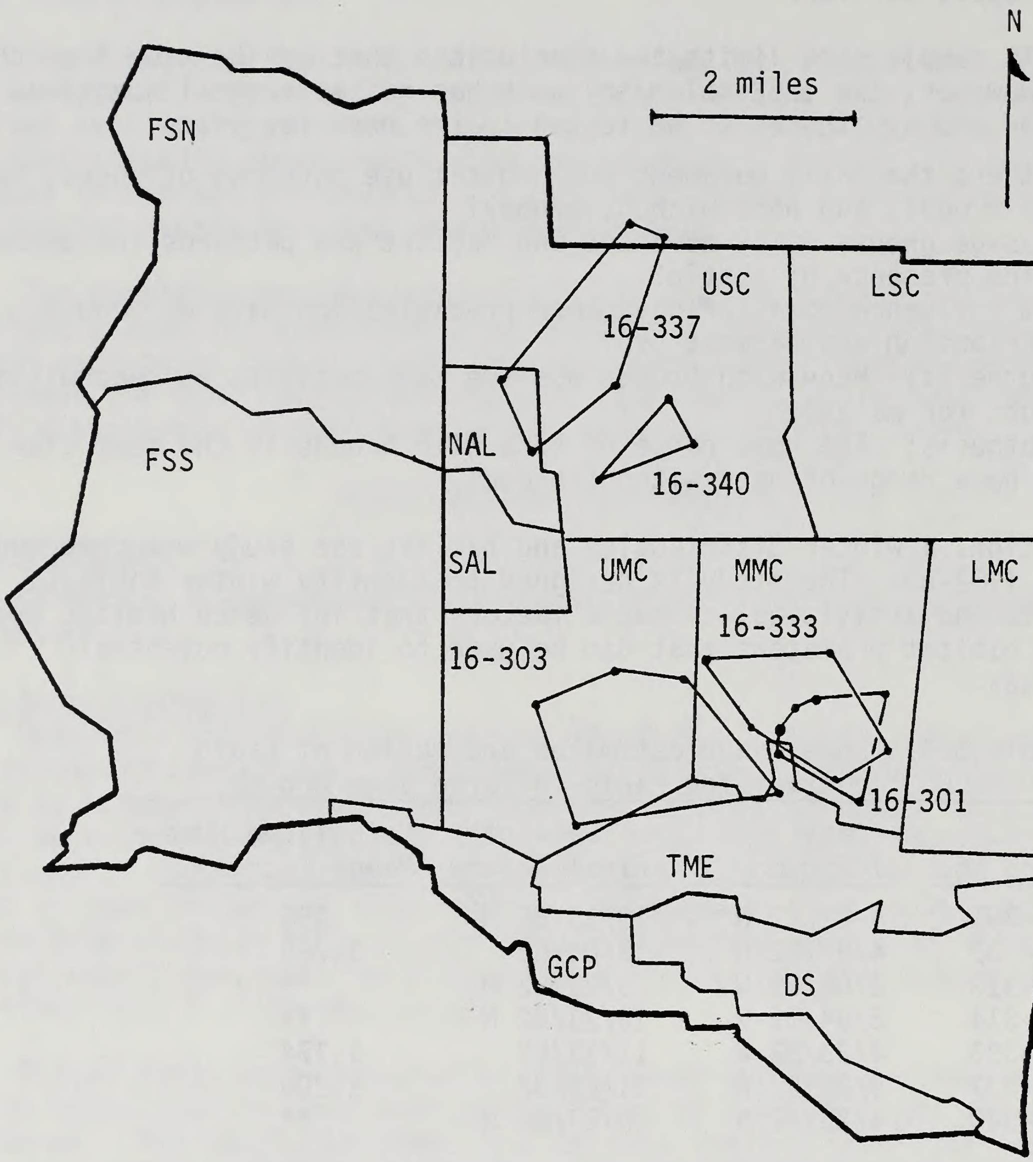


Figure 3.1. Locations of summer ranges for radio-collared females.

LITERATURE CITED

Beck, T.D.I. 1977. Sage grouse flock characteristics and habitat selection in winter. J. Wildl. Manage. 41:18-26.

Dalke, P.D., D.B. Pyrah, D.C. Stanton, J.E. Crawford, and E.F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. J. Wildl. Manage. 27:811-841.

Jenni, D.A. and J.E. Hartzler. 1978. Attendance at a sage grouse lek: implications for spring censuses. J. Wildl. Manage. 42:46-52.

Klebenow, D.A. 1969. Sage grouse nesting and brood habitat in Idaho. J. Wildl. Manage. 33:649-662.

Martin, N.S. 1970. Sagebrush control related to habitat and sage grouse occurrence. J. Wildl. Manage. 34:313-320.

Oakleaf, R.J. 1971. The relationship of sage grouse to upland meadows in Nevada. Nev. Coop. Wildl. Res. Rep., Reno, NV. 64pp.

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Inc., Denver, Colo. 341pp.

Peterson, B.E. 1980. Breeding and nesting ecology of female sage grouse in North Park, Colorado. M.S. Thesis. Colorado State Univ., Fort Collins. 86pp.

Peterson, J.F. 1970. The food habits and summer distribution of juvenile sage grouse in central Montana. J. Wildl. Manage. 34:147-155.

Savage, D.E. 1969. The relationship of sage grouse to upland meadows in Nevada. Nev. Coop. Wildl. Res. Rep., Reno, NV. 101pp.

Schoenberg, T.J. 1982. Potential impacts of strip mining on sage grouse movements and habitat use. Colo. Div. Wildl. Rep. 89pp.

Wallestad, R.O. 1971. Summer movements and habitat use by sage grouse broods in central Montana. J. Wildl. Manage. 35:129-136.

Wallestad, R.O. and D.B. Pyrah. 1974. Movement and nesting of sage grouse hens in central Montana. J. Wildl. Manage. 38:630-633.

Wallestad, R.O. and P. Schladweiler. 1974. Breeding season movements and habitat selection of male sage grouse. J.Wildl. Manage. 38:634-637.

LITERATURE CITED

Beck, T.D.I. 1977. Sage grouse flock characteristics and habitat selection in winter. J. Wildl. Manage. 41:18-26.

Dalke, P.D., D.B. Pyrah, D.C. Stanton, J.E. Crawford, and E.F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. J. Wildl. Manage. 27:811-841.

[illegible], [illegible] and [illegible]. [illegible]. [illegible] a sage grouse [illegible]: implications for [illegible]. J. Wildl. Manage. [illegible].

Klebenow, D.A. 1969. Sage grouse nesting and brood habitat in Idaho. J. Wildl. Manage. 33:649-662.

Martin, N.S. 1970. Sagebrush control related to habitat and sage grouse occurrence. J. Wildl. Manage. 34:313-320.

Oakleaf, R.J. 1971. The relationship of sage grouse to upland meadows in Nevada. Nev. Dept. [illegible]. [illegible] pp.

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Inc., Denver, Colo. [illegible]

Petersen, B.E. [illegible]. Breeding and nesting ecology of female sage grouse in North Park, Colorado. M.S. Thesis. Colorado State Univ., Fort Collins. [illegible]

Peterson, J.G. 1970. The food habits and summer distribution of juvenile sage grouse in central Montana. J. Wildl. Manage. 34:147-155.

Savage, D.E. 1969. The relationship of sage grouse to upland meadows in Nevada. Nev. Coop. Wildl. Res. [illegible]. [illegible]

Schoenberg, T.J. [illegible]. [illegible] sage grouse movements and habitat [illegible]. [illegible]

Wallestad, R.O. 1971. Summer movements and habitat use by sage grouse broods in central Montana. J. Wildl. Manage. 35:129-136.

Wallestad, R.O. and D.B. Pyrah. 1974. Movement and nesting of sage grouse hens in central Montana. J. Wildl. Manage. 38:630-633.

Wallestad, R.O. and P. Schladweiler. 1974. Breeding season movements and habitat selection of male sage grouse. J. Wildl. Manage. 38:634-637.

CHAPTER 4

SPECIES COMPOSITION OF TAMED DEER DIETS

Debra Selby and Donald A. Klebenow

1982 Objectives:

1. Determine the botanical composition of mule deer summer diets on the Forest Service allotment through the use of tame deer.

2. Provide data input to determine the extent, if any, of competition between mule deer and cattle.

1982 Accomplishments:

Four tamed yearling deer, one buck and three does, were observed throughout the summer to obtain species composition of deer diets. Two sites were chosen where deer and cattle are known to occur. The South Forest Service site was selected to represent early summer cattle and deer interaction, whereas the North Forest Service site was selected to represent late summer cattle and deer interaction.

On each site a 25 ft by 25 ft pen was constructed to contain the deer between foraging trials.

Study sites were made up of ten habitat types. Vegetation in each type was described by percent foliar and basal area cover of each species.

For deer diet trials, 2-week observation periods were alternated between the two sites using two to three deer three times a week. Trials were conducted in early morning, for a 1-hour period for each deer. During the hour, as one deer was followed, each bite of vegetation removed was recorded into a hand held tape recorder. Each week, simulated bites of each plant species the deer foraged on was hand plucked and weighed to determine average biomass of a deer bite.

During the summer, 17,430 deer bites were observed. The number of bites for a 1-hour trial for the does ranged from 308 to 400 bites, whereas the buck averaged 241 bites.

The total number of shrub species each deer consumed throughout the summer, ranged from 8 to 14. The variety of forbs selected by each deer ranged from 21 to 67 species. Although grasses did not contribute to a major part of deer diets, six species were utilized.

Preliminary analysis of the data indicates a progression to different plant species based on phenology and, in some habitat types, on grazing cattle.

In the first sampling period, on the South Forest Service before cattle grazed, deer indicated a preference for forbs (Table 4.1). The percent of deer bites on forbs ranged from 62 to 94%. No grass was eaten. During this early June period, willow was the only shrub that contributed to at least 10% of the diet for Doe 1 and 2 in any one trial (Table 4.2). A variety of forbs was prevalent in Doe 1's diet, including buckwheat, bluebells, Solomons seal, American bistort and violet. The two species of forbs that were significant

Table 4.1. Forage selection by tame deer, Sayal Ranch Research Project, 1982.

Trial	Time, Location, & Treatment	Animal	Percent of Bites Taken		
			Shrubs	Forbs	Grasses
1	Early June	Doe 1	11	89	0
	South Forest Service	Doe 2	6	94	0
	Before grazing by cattle	Doe 3	38	62	0
		Buck		No trials	
2	Late June	Doe 1	61	37	2
	North Forest Service	Doe 2		No trials	
	Before grazing by	Doe 3	77	23	0
	cattle	Buck	90	9	T
3	Early and mid-July	Doe 1	28	71	1
	South Forest Service	Doe 2	23	77	0
	During grazing	Doe 3		No trials	
		Buck	53	45	2
4	Late July	Doe 1	60	39	1
	North Forest Service	Doe 2		No trials	
	Before grazing	Doe 3	95	5	T
		Buck	89	10	1
5	Early to mid-August	Doe 1	86	14	T
	North Forest Service	Doe 2	99	1	0
	During and after	Doe 3	93	6	1
	grazing	Buck	97	3	T

Table 4.2. Forage species contributing to at least 10% of deer diet in any one trial, Saval Ranch Research Project, 1982.

Trial	Time, Location & Treatment	Doe 1	Doe 2	Doe 3	Buck
1	Early June South Forest Service Before grazing by cattle	Willow Buckwheat Shortstyle bluebells Starry false Solomons-seal American bistort Violet	Willow Buckwheat Shortstyle bluebells	No shrubs Mules ear Carrotleaf lomatium Cow cabbage	No trials
2	Late June North Forest Service Before grazing by cattle	Bitterbrush Serviceberry Wild rose Gooseberry Buckwheat Bedstraw	Wild rose Gooseberry Cow cabbage	No trials	Bitterbrush Serviceberry Wild rose Currantbush Peony Wild onion
3	Early and mid-July South Forest Service During grazing	Bitterbrush Serviceberry Willow Carrotleaf lomatium Shortstyle bluebells Collomia Buckwheat	No trials	No shrubs Carrotleaf lomatium Paintbrush	Wild rose Serviceberry Carrotleaf lomatium Shortstyle bluebells Collomia Stickweed
4	Late July North Forest Service Before grazing	Wild rose Bitterbrush Douglas knotweed Potentilla	Wild rose Bitterbrush No forbs	No trials	Wild rose Serviceberry No forbs
5	Early to mid-August North Forest Service During and after grazing	Serviceberry Wild rose Bitterbrush No forbs	Serviceberry Wild rose Bitterbrush Gooseberry No forbs	Serviceberry Wild rose Bitterbrush No forbs	Serviceberry Wild rose No forbs

in Doe 2's diet were bluebells and buckwheat. The major species in Doe 3's diet were mulesear, lomatium, and cow cabbage.

Percent of shrubs in deer diets increased in the second trial period on the North Forest Service (Table 4.1). The buck showed a high preference for shrubs, 90%. Grasses were not an important part of the diet during this late June period.

Table 4.2 shows bitterbrush, serviceberry, wildrose and gooseberry as the important shrubs in Doe 1's diet. Major forbs were buckwheat and bedstraw. Doe 2 had a high preference for wild rose and gooseberry, while cow cabbage appeared as the only forb of importance. The buck, as previously mentioned, showed a high preference for shrubs. Bitterbrush, serviceberry, wild rose and currantbush were all important species in his diet. Forbs comprising at least 10% of his diet were peony and wild onion.

The third trial period on the South Forest Service Pasture, during cattle grazing, found that all deer diets contained a high percentage of forbs (Table 4.1). The high forb content was almost exclusively made up of lomatium, which at that time was bearing a mature succulent fruit. Figure 4.1 shows the role of lomatium in Doe 1's diet throughout the summer. Lomatium was prevalent in four trials conducted in July. Figure 4.2 shows lomatium was also important to the buck during early to mid-July.

Table 4.2 points out the major shrub and forb species in the third sampling period. Doe 1 had a preference for bitterbrush, serviceberry and willow, whereas the buck chose similar species but preferred rose to bitterbrush. In addition to lomatium, preferred forbs included bluebells, collomia, buckwheat, paintbrush, and stickweed.

In late July, trials on the North Forest Service Pasture indicated a switch by the deer to selecting more brush and less forbs (Table 4.1). Again, deer did not select for grasses.

Table 4.2 shows that all deer selected for wild rose. The two does also added bitterbrush to their diets and the buck added serviceberry. The only forbs consisting of more than 10% of deer diets during this period were knotweed and potentilla selected by Doe 1.

During the final trials on the North Forest Service deer made a significant change in their diets from forbs to brush (Table 4.1). At this time, most brush species were in fruit, making them more palatable to deer, whereas the forbs were in a cured condition, making them less desirable for deer comsumption.

All deer selected serviceberry and wildrose; does also chose bitterbrush and gooseberry (Table 4.2).

Effect of cattle grazing

No impact of cattle grazing was detected during the 1982 field season. While the percent shrubs increased in deer diets from the North Forest Service Pasture as the summer progressed, it was not possible to separate differences

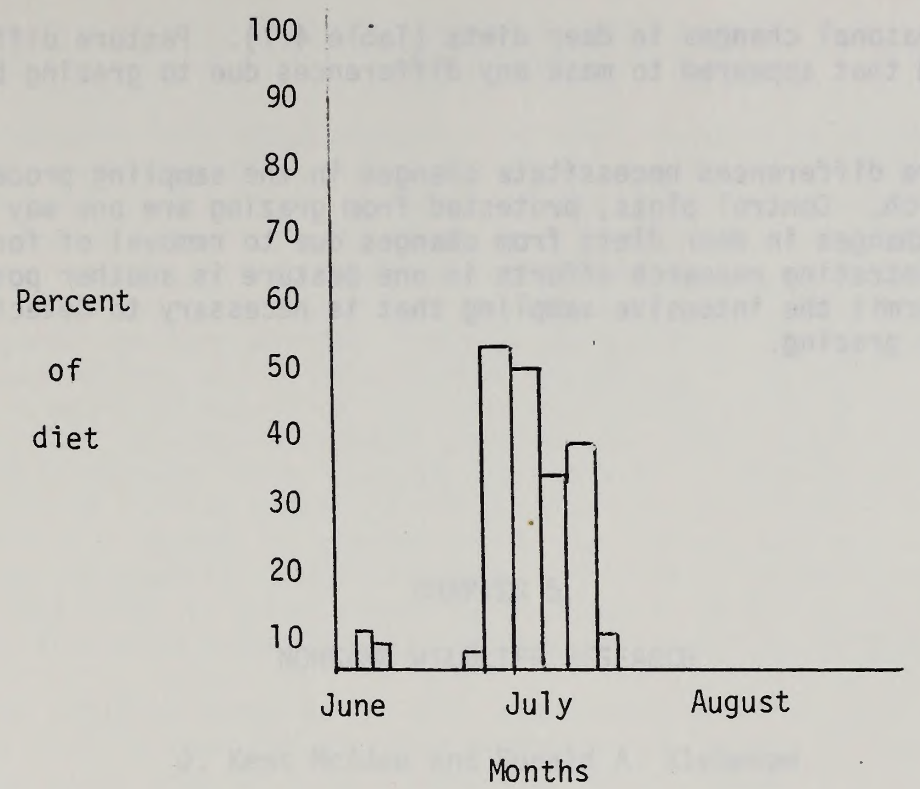


Figure 4.1. Percent of carrotleaf lomatium in the diet of doe 1, summer, 1982.

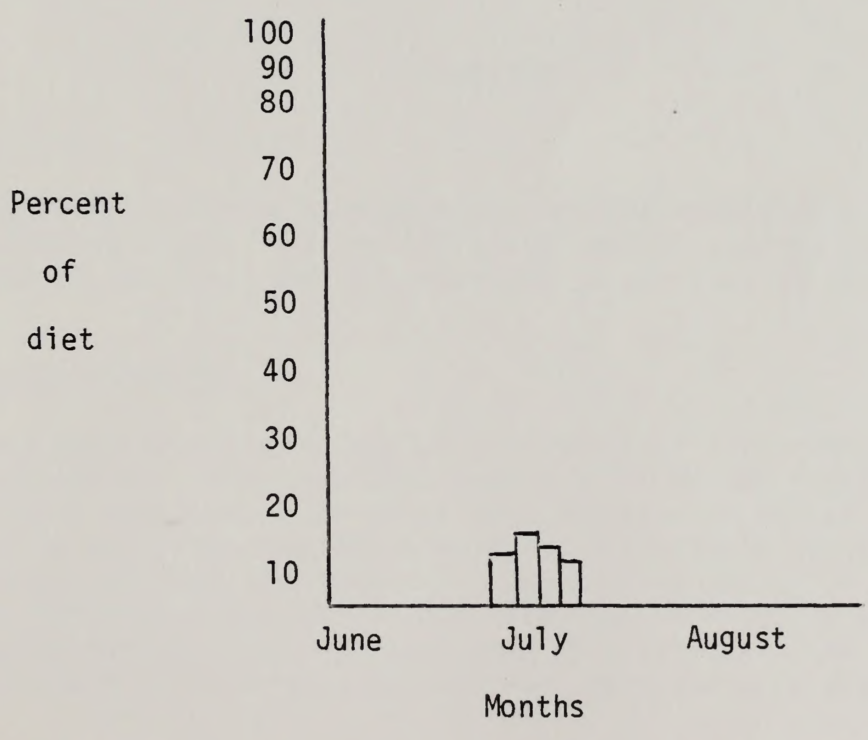


Figure 4.2. Percent of carrotleaf lomatium for buck, summer 1982.

due to natural seasonal changes in deer diets (Table 4.1). Pasture differences in diets occurred that appeared to mask any differences due to grazing by cattle (Table 4.1).

These pasture differences necessitate changes in the sampling procedure for future research. Control plots, protected from grazing are one way to separate normal changes in deer diets from changes due to removal of forage by cattle. Concentrating research efforts in one pasture is another possibility that will permit the intensive sampling that is necessary to detect effects of cattle grazing.

CHAPTER 5

NONGAME WILDLIFE RESEARCH

J. Kent McAdoo and Donald A. Klebenow

GENERAL RESEARCH OBJECTIVES AND APPROACH

The primary long-range objective of this research is to determine population responses of nongame wildlife to vegetation changes brought about by grazing management systems. An important short-range objective is to determine the effects of range improvement practices (i.e., brush control and mixed species rangeland seeding) on nongame wildlife.

Research has been divided into two categories: (1) key range site/animal communities, and (2) representative species. Sampling of the former provides a means of detecting the sometimes subtle wildlife community changes (e.g., relative abundance, species diversity) which often result from habitat change. This approach also serves to indicate whether the representative species chosen for more intensive study are as important as originally presumed, or whether other species are more responsive to land management treatments. Emphasis during the current "interim grazing system" period (1981-1983) is being placed on this key range site/animal community approach, involving primarily the sampling of rodent and bird populations.

Range sites referred to in this report were based on soil, vegetation, and precipitation zone (abbreviated hereafter as "p.z.") as mapped by SCS on the study area in 1978. Vegetation descriptions of these range sites are available in the "Vegetation Research" chapter of the April, 1982 Saval Ranch Research and Evaluation Study Progress Report. Pastures sampled will be referred to by their abbreviations: LSC = Lower Sheep Creek, USC = Upper Sheep Creek, DS = Darling Seeding, NC = Native Control, UMC = Upper Mahala Creek, LMC = Lower Mahala Creek, SFS = South Forest Service, and NFS = North Forest Service.

RODENTS

1982 Objective:

To determine relative abundance and species composition of rodents in the following areas: (a) the LSC mixed species seeding and a control site in the USC pasture, and (b) important range sites of other pastures.

1982 Accomplishments:

Rodent populations were sampled with grids of live traps for four consecutive nights. When possible, square grids of 100 traps (with 50 ft. between traps) were used. The traps were baited with rolled oats and checked twice daily (morning and evening). All animals caught were ear-tagged, sexed, weighed, and released. We used the number of rodents caught per 400 trap-nights as minimum estimates of relative abundance for each trapping period. Tag-recapture data will eventually be used in a modified Lincoln Index formula to make more accurate population estimates.

Eighteen trap grids were conducted during 1982. These grids were located in 9 range sites and distributed within 7 of the grazing system pastures. We caught 578 rodents during this sampling effort of 6800 trap-nights. This obvious decrease from the sampling effort of 1981 (10,190 trap-nights) was due partly to a reduction in number of summer employees (from 2 in 1981 to 1 in 1982), and partly to a switch in research emphasis from rodents to birds.

Trapping effort was concentrated on the sagebrush dominated BLM pastures (14 grids total), with special emphasis placed on the LSC seeding and a USC control site. Relative abundance values of rodents (number caught per 400 trap-nights) are listed in Table 5.1 for the 5 most abundant species and total rodent populations on BLM grids trapped in both 1981 and 1982. (1981 values are listed for comparative purposes, since those in last year's report were density values rather than relative abundance).

During 1982, total rodent abundance increased with time for all range sites trapped more than once during the summer (Table 5.1). Comparing equivalent sites and time periods trapped for 1981 and 1982, total rodent abundance was consistently lower in 1982, except for the August trapping of the USC Loamy 8-10" p.z. range site. Total rodent populations in 1982 averaged 43% lower than those of 1981. There are several possible explanations for this. The more severe winter of 1981-82 (personal communication, John Barber), compared to that of 1980-81 may have caused a die-off. The long cool, wet spring of 1982 may have likewise resulted in lower rodent numbers, or possibly even added to the winter mortality. However, we believe that the greater availability of forage (especially forbs), also the result of the wet 1982 spring, may have had the greatest impact. When natural food sources are abundant, rodents are not nearly so attracted to bait in traps as when natural food sources are limited. The increase in numbers of rodents caught in late summer of 1982 is evidence for this (e.g., rodent abundance values increased from 27 in June to 79 in August on the USC loamy 8-10" p.z. range site). As native forage dries up and disappears, rodents are probably more attracted to the bait in traps.

The differences in rodent abundance (or differential responses to baited traps, whichever the case) between 1981 and 1982 make before and after comparisons on the LSC seeding difficult. A more valid way of determining effects of the seeding on rodent populations is to compare relative abundance values of rodents caught in the seeding with those caught in the USC control site. Total rodent abundance was consistently higher on the control site than on the seeding during each sampling period. Total abundance values were 27, 37, and 79 for June, July, and August, respectively, on the USC control grid, compared to 10, 28, and 54 for the same time periods on the LSC seeding (Table 5.1).

The effect of the LSC seeding on least chipmunks was most responsible for the lower total rodent abundance values on this site. During 1982 (after the area was seeded) no chipmunks were caught during either the June or August trapping periods, and only one was caught in July (Table 5.1). Comparatively, on the control site during 1982, 8 were caught in June, 16 in

Table 5.1. Relative abundance of rodents trapped on Saval Ranch BLM pastures in 1981 and 1982.

Range Site/Status	Pasture	Month trapped	Deer Mouse Yr 81	Deer Mouse Yr 82	Great Basin Pocket Mouse Yr 81	Great Basin Pocket Mouse Yr 82	Least Chipmunk Yr 81	Least Chipmunk Yr 82	Mountain Vole Yr 81	Mountain Vole Yr 82	Sagebrush Vole Yr 81	Sagebrush Vole Yr 82	All Other Species Yr 81	All Other Species Yr 82	Total Yr 81	Total Yr 82
			Relative Abundance (no./400 trap-nights) by Species													
Crested wheatgrass/grazed in 1981 and 1982	DS[1]	Jun	40	6	4	1	6	1	0	0	1	1	1	0	52	9
Loamy 8-10"p.z.[2]/grazed in 1981 and 1982 (control grid for the LSC seeding)	(1)[3] USC	Jun	x[4]	12	x	7	x	8	x	0	x	0	x	0	x	27
	(2)	Jul	31	13	21	8	12	16	0	0	1	0	5	0	70	37
	(3)	Aug	30	34	16	24	11	19	0	0	1	1	1	1	59	79
Loamy 8-10" p.z./grazed In 1981, seeded and ungrazed in 1982	(1) LSC	Jun	x	5	x	5	x	0	x	0	x	0	x	0	x	10
	(2)	Jul	22	13	30	12	11	1	0	0	1	1	2	1	66	28
	(3)	Aug	26	35	17	12	19	0	0	0	0	4	4	3	66	54
Loamy bottom 10-14"p.z./grazed in 1981, left ungrazed within seeding in 1982	(1) LSC	May	16	13	5	6	4	0	10	0	0	0	2	1	37	20
	(2)	Jun	30	16	11	6	17	0	0	7	2	0	0	1	60	30
	(3)	Jul	34	17	19	2	20	7	1	16	0	0	2	1	76	43
Loamy 10-12"p.z./grazed in 1981 and 1982	USC	Jun	47	6	18	11	10	18	0	0	0	0	0	1	76	37
Loamy 10-12"p.z./ungrazed in 1981 and 1982	(1) NC	May	x	8	x	5	x	4	x	0	x	0	x	0	x	17
	(2)	Jul	44	11	18	19	13	11	0	0	2	1	1	1	78	43
Claypan 10-12"p.z./grazed in 1981, ungrazed in 1982	UMC	Aug	48	14	21	9	8	5	0	0	0	2	1	0	78	30

[1] DS = Darling seeding, USC = Upper Sheep Creek, LSC = Lower Sheep Creek, NC = Native Control, UMC = Upper Mahala Creek.

[2] p.z. = precipitation zone.

[3] Numbers in parentheses refer to repeated sampling of the same grid over time.

[4] x = site not trapped during 1981.

July, and 19 in August. Data from 1981 indicate that chipmunks were present on the LSC site before seeding in numbers comparable to those on the USC control. Least chipmunks are more arboreal than any of the other species listed, and therefore are more dependent on the presence of sagebrush. The LSC pasture was plowed to control sagebrush prior to seeding, and although a 60% control was sought, sagebrush mortality on the LSC grid was probably higher than this.

We conducted four trap-grids on the Forest Service pastures during 1982. Three of these were also trapped in 1981. Comparison of equivalent grids for the 2 years reflected lower rodent abundance values during 1982 (paralleling the lower values previously discussed for BLM grids in 1982). One very interesting difference between the 1981 and 1982 trapping of these grids was the presence of insectivores in 1982. We caught a total of seven Merriam's shrews on these sites in 1982, and none in 1981. These were the first shrews caught in rodent traps on the study area since a northern water shrew was caught in 1979 in a riparian site. (Nineteen shrews, representing 3 species, were caught last year, but these were caught in pit-fall traps especially placed for insectivore inventory). We believe the presence of Merriam's shrews on 1982 rodent grids may indicate an increase in shrew numbers on at least some upper elevation range sites in the study area.

BIRDS

1982 Objective:

To determine relative abundance and species composition of bird populations in the following areas: (a) various riparian areas in the Forest Service pastures, (b) the new LSC mixed species seeding and a USC control area, and (c) other BLM range sites.

1982 Accomplishments:

Bird transects were conducted beginning at sunrise for three consecutive days (weather permitting), and consisted of five-minute stops at 10 variable circular plots 0.3 mi apart. All birds seen and heard were recorded at each stop. Area sampled for each plot will be eventually determined by averaging the detection distances for individuals of each species.

We conducted 16 bird transects in 7 pastures during 1982. Because of the length of these transects, most of them passed through two or more range sites. In this manner, we sampled bird populations in at least 9 range sites on the study area.

Emphasis was placed on sampling bird populations in riparian habitats this year. Because these areas support the greatest diversity and abundance of bird life on the study area, changes in range condition caused by cattle grazing management should eventually result in detectable changes in bird populations here. Riparian zones are typically more affected by

grazing than other habitats because cattle are attracted to the lush vegetation, water, and shade provided by these areas. The riparian zones we sampled were comprised primarily of the wet meadow and riparian aspen range sites.

Bird transects in riparian zones were located along four drainages: Gance Creek, Jim Creek, Mahala Creek (all in the SFS pasture), and Stump Creek (in the NFS pasture). Gance Creek and Jim Creek were each sampled twice, once before they were grazed by cattle and once after grazing (Table 5.2). Although some changes were evident over time in both of these areas, we believe these were due more to the differential responses of birds to the gradual winding down of the breeding season than to cattle grazing.

Bird abundance was highest along the Mahala Creek transect (ungrazed at the time), with 150.8 birds per transect-day (Table 5.2). The total number of species varied little from one drainage to another, with a high value of 23 on the early Gance Creek transect.

Table 5.2 includes specific mention of only the 12 most common species in the riparian areas sampled. For several of these species there are some obvious differences among the drainages sampled. House wrens, common flickers, and warbling vireos were most abundant along Jim Creek and Stump Creek during comparable time periods (mid to late June). All three of these species are closely associated with aspen trees: house wrens and flickers are cavity nesters and vireos nest in the upper canopy. Although aspen trees occur along each of the transects, they are more common along the Jim and Stump Creek transects.

Yellow warblers were one of the most abundant species in each area, comprising 9.6 to 17.7% of total bird populations (Table 5.2). This species, though typically associated with willows, was also found nesting in aspen trees.

Fox and song sparrows were much more abundant on the Gance Creek transects than anywhere else (Table 5.2). This area has probably the most dense willow vegetation and largest continuous stands of willows than any of the drainages sampled. These two shrub nesters apparently thrive under these conditions. Robins were also much more abundant along Gance Creek (especially in June) than in the other areas.

Green-tailed towhees were most common along the Mahala Creek and Stump Creek transects in June, and along Jim Creek in July. Another shrub nester, this species may be attracted to the more open canopy serviceberry-sagebrush-willow habitat which is plentiful along these three transects.

Brewer's sparrows were most common along Mahala Creek and Stump Creek (Table 5.2). Portions of the transects along these drainages are extensively invaded with big sagebrush. Since Brewer's sparrows are sagebrush community obligates, their abundance in sagebrush-invaded riparian areas is not surprising.

Table 5.2. Relative abundance and species composition of birds in riparian habitats located in the Forest Service pastures at the Saval Ranch during summer, 1982.

Species	Gance Cr.-SFS[1](1)[2] 6/18-ungrazed $\bar{x}$[3] %[4]	Gance Cr.-SFS(2) 7/16-grazed $\bar{x}$ %	Jim Cr.-SFS(1) 6/15-ungrazed $\bar{x}$ %	Jim Cr.-SFS(2) 7/12-grazed $\bar{x}$ %	Mahala Cr.-SFS 6/18-ungrazed $\bar{x}$ %	Stump Cr.-NFS 6/28-ungrazed $\bar{x}$ %
House wren	10.0 (7.7)	8.7 (7.3)	14.3 (11.0)	16.7 (15.5)	14.7 (9.7)	12.3 (9.1)
Common flicker	1.0 (0.8)	5.0 (4.2)	14.7 (11.3)	4.7 (4.4)	5.3 (3.5)	6.7 (4.9)
Warbling vireo	5.0 (3.8)	3.7 (3.1)	11.0 (8.5)	9.0 (8.4)	8.0 (5.3)	13.3 (9.8)
Yellow warbler	23.0 (17.7)	16.0 (13.4)	16.0 (12.3)	11.7 (10.9)	17.7 (11.7)	13.0 (9.6)
Fox sparrow	15.0 (11.5)	14.7 (12.3)	0.3 (0.2)	1.3 (1.2)	2.0 (1.3)	2.0 (1.5)
Song sparrow	9.3 (7.2)	8.7 (7.3)	0.7 (0.5)	0.7 (0.7)	2.0 (1.3)	0.0 (0.0)
Robin	26.0 (20.0)	8.0 (6.7)	5.7 (4.4)	3.3 (3.1)	10.7 (7.1)	7.0 (5.2)
Green-tailed towhee	11.3 (8.7)	10.0 (8.4)	8.7 (6.7)	22.3 (20.7)	17.7 (11.7)	19.3 (14.2)
Lazuli bunting	6.0 (4.6)	8.0 (6.7)	4.0 (3.1)	8.0 (7.4)	4.3 (2.9)	6.3 (4.6)
Brewer's sparrow	5.7 (4.4)	1.7 (1.4)	4.7 (3.6)	1.7 (1.6)	13.7 (9.1)	17.3 (12.7)
Mourning dove	0.0 (0.0)	5.7 (4.8)	4.0 (3.1)	4.3 (4.0)	18.7 (12.4)	1.0 (0.7)
Empidonax flycatcher	3.7 (2.8)	8.3 (7.0)	12.3 (9.5)	7.3 (6.8)	8.7 (5.8)	5.0 (3.7)
Other species	14.0 (10.8)	20.9 (17.5)	33.3 (25.7)	16.6 (15.4)	27.3 (18.1)	32.6 (24.0)
Total	130.0 (100)	119.4 (100)	129.7 (100)	107.6 (100)	150.8 (100)	135.8 (100)
No. of species	23	21	21	21	21	22

[1]SFS = South Forest Service, NFS = North Forest Service.

[2]Numbers in parentheses refer to repeated sampling of the same transect over time.

[3]$\bar{x}$ = relative abundance expressed as mean number of birds observed per transect-day

[4]% = species composition.

Mourning doves were far more abundant along the Mahala Creek transect (18.7 birds per transect-day) than in any of the other riparian areas (Table 5.2). The reasons for this are not at all clear. However, the Mahala Creek area seems to be more open (possibly the result of past cattle concentrations) than the other riparian areas sampled. Whether or not this makes it more attractive as dove habitat is not known at this time. We plan to sample vegetation on each of the riparian transects this summer in an attempt to determine more exactly the reasons for differences in bird populations among the drainages.

A special effort was made to interpret the effects of the new LSC mixed species seeding on bird pupulations (Table 5.3). We examined the changes in bird abundance which occurred on the seeded area between the summers of 1981 and 1982 (before and after brush control and seeding), and for the same periods along a control transect. When changes over time are considered for the seeded area alone, meadowlarks appear to have increased 300% (4 birds per transect-day in 1981, 12.4 in 1982). There were also <u>apparent</u> increases in abundance of sage thrashers and horned larks, and <u>apparent</u> decreases in vesper sparrows, Brewer's sparrows, and gray flycatchers. However, when changes over time are considered for the USC control site, the apparent changes in the LSC seeding must be re-evaluated.

For example, the 3-fold increase in western meadowlarks on the seeded area is not so impressive when compared to the nearly 5-fold increase in meadowlarks on the USC control area from 1981 to 1983 (Table 5.3). We have concluded that the general increase in meadowlarks on both areas was probably in response to climatic factors, possibly the long cool, wet spring of 1982 (personal communication, John Barber). When each of the species are examined in this manner, the only changes which seem to be related to the seeding are those which occurred for Brewer's sparrows, horned larks, and gray flycatchers.

Although Brewer's sparrows decreased during 1982 both on the seeding and on the control (Table 5.3), they decreased by 30% on the seeding, but only by 11% on the control. A decrease in this species on the seeding was expected because of sagebrush control on the area. Brewer's sparrows are obligates of sagebrush communities, depending on the shrubs for nest sites. However, since brush control on the seeding was not 100% (a 60% kill was the goal), this species still remained on the area. On another study area in central Nevada with seedings where brush was completely removed, we observed the near elimination of Brewer's sparrows during the first year after brush control and seeding.

Horned lark populations on the control area remained virtually the same in 1981 and 1982 (6.0 and 5.9 birds per transect-day, respectively) (Table 5.3). However, horned larks increased by 35% (from 14.3 to 19.3 birds per transect-day) on the LSC area after it was seeded. This ground-nesting species probably responded more to sagebrush removal than to the grasses and forbs that were seeded.

Table 5.3. Relative abundance and species composition of birds in the Saval Ranch Lower Sheep Creek pasture (before seeding in 1981 and after brush control and mixed species seeding in 1982) and in the grazed Upper Sheep Creek pasture control site.

	Upper Sheep Creek Control Yr and treatment				Lower Sheep Creek Seeding Yr and treatment			
	1981/grazed		1982/grazed		1981/pre-seeding grazed		1982/after plowing and seeding, ungrazed	
Species	$\bar{x}$[1]	(%)[2]	$\bar{x}$	(%)	$\bar{x}$	(%)	$\bar{x}$	(%)
Western meadowlark	3.3	(5.5)	16.0	(19.4)	4.0	(5.1)	12.4	(14.4)
Vesper sparrow	17.0	(28.5)	12.9	(15.6)	14.0	(17.9)	11.8	(13.7)
Sage thrasher	13.7	(22.9)	19.4	(23.5)	15.0	(19.2)	19.2	(22.4)
Brewer's sparrow	16.7	(28.0)	14.9	(18.0)	25.7	(32.8)	18.0	(21.0)
Horned lark	6.0	(10.1)	5.9	(7.1)	14.3	(18.3)	19.3	(22.5)
Gray flycatcher	2.7	(4.5)	5.5	(6.7)	2.7	(3.3)	0.5	(0.6)
Other species	0.3	(0.5)	8.0	(9.7)	2.6	(3.3)	4.7	(5.5)
Total	59.7	(100)			78.3	(100)	85.9	(100)
No. of species	7		10		8		11	

[1] $\bar{x}$ = relative abundance expressed as mean number of birds observed per transect-day.

[2] % = species composition.

The third species that may have been affected by the seeding was the gray flycatcher. Although sample size was small, this species almost doubled in abundance on the control area, but decreased by 82% on the seeding.

We expect more changes in bird populations to occur on the seeding as it becomes established with time. For example, the increase in herbaceous cover brought about by the seeding might eventually result in an increase in meadowlarks, since these birds typically prefer a more dense understory for nesting. We will continue monitoring the seeding in order to detect changes in bird populations as they occur.

Six other bird transects were conducted in low elevation range sites in the BLM pastures. The results of these transects will be used for comparative purposes as the grazing system is implemented. Five of these transects were also sampled during summer, 1981. Comparison of data gathered on these transects indicates that over-all breeding-bird densities on the Saval Ranch peaked approximately 2-3 weeks later in 1982 than in 1981. This later breeding season was apparently brought about by the later arrival of warm weather on the study area in 1982 (personal communication, John Barber).

JACKRABBITS

1982 Objectives:

(1) To estimate black-tailed jackrabbit densities in the low elevation sagebrush dominated BLM pastures.

(2) To determine utilization by jackrabbits of the new LSC mixed species seeding.

1982 Accomplishments:

Estimates of jackrabbit density were made by walking strip census transects 3 mi in length in the major low elevation range sites. (Because of the length of these lines, they often crossed several range site boundaries). Transects were conducted during mid-day when lagomorphs are most sedentary. Perpendicular flushing distance (from the transect-line) was recorded for each rabbit flushed. Densitites were determined for each transect by this formula:

$$\text{Density} = n/2l\bar{r}$$

where n = number of rabbits flushed, l = length of transect, and $\bar{r}$ = mean flushing distance.

Jackrabbit sampling was not a high priority item this year, but we conducted six transects in three BLM pastures (UMC, USC, and LSC) in order to get an indication of jackrabbit densities. These transects were all conducted in the big sagebrush-alkali sagebrush upland mosaic habitat which

dominates the BLM pastures. Major range sites included in this mosaic were the Loamy 8-10" p.z., Loamy 10-12" p.z., and Claypan 10-12" p.z. sites. Mean jackrabbit density this year was only 23/mi^2, the lowest on the study area since 1978. Jackrabbits peaked in 1980 (200/mi^2) and have been on a downward trend since then.

In order to determine jackrabbit utilization of the recently planted mixed species seeding in the Lower Sheep Creek pasture, we established 48-10.8 yd^2 pellet plots. These were arranged in 4 replications of 6 plots each at the edge of the seeding and at 400 yd (approximately halfway) into the seeding. We cleared all jackrabbit pellets from these plots, then counted the pellets deposited during a one month period (September).

There was no significant difference ($p = .05$) in jackrabbit utilization of the seeding between the seeding edge and at 400 yd. This was apparently due to the low jackrabbit density in the area. Using some conversion factors, we estimated that jackrabbits consumed only 1.3 lb/ac of seeded vegetation during September. This is a very low value compared to others we have calculated for eastern and central Nevada seedings surrounded by sagebrush habitat with much higher jackrabbit densities (up to 600/mi^2).

COYOTES

1982 Objective:

To monitor yearly population fluctuations (trend).

1982 Accomplishments:

Continuing our index of coyote populations, we conducted howl count surveys (driven route) consisting of seven stops, 3 mi apart. This route was located along major dirt roads which cross the study area. At each stop, a mouth-blown "howler" was sounded for 20 seconds, followed by a 2-minute listening period during which time all elicited coyote howls were recorded. Age class and location (habitat and approximate distance from investigator) were recorded for each responding animal. Howling was done at night and only when windspeed was less than 8-10 mi/hr, since higher windspeeds may bias results.

We conducted two howl count surveys (1 in July, 1 in September). Twenty-seven coyotes responded on the July route, but only six during the September sampling. Because of the high variability in coyote response, the greatest number of coyotes counted on any given summer route is used for that year's population index. According to the indices, coyote abundance peaked in 1981 (index = 36), one year following the peak in jackrabbit density. We expect that the coyote population will continue to decline next year in response to this year's low jackrabbit density on the study area.

CHAPTER 6

FISHERIES RESEARCH

William S. Platts and Rodger Loren Nelson

William E. Platts and Walter Loren Nelson

GENERAL RESEARCH OBJECTIVES

The study goals for the 1982 fiscal year embodied continuation of the time trend analysis of fishery and riparian habitat conditions on Gance Creek. This is in agreement with the overall objectives of the fisheries phase of the Saval Ranch Project and the Livestock-Fishery Interaction studies, more fully described previously by Platts and Nelson[1/], which include the following:

1. Determine the rehabilitative potential of Gance Creek based on past, present, and future livestock grazing strategies;

2. Evaluate the usefulness of excluding livestock from the Gance Creek riparian zone by studying protected habitat within a fenced exclosure;

3. Evaluate the compatibility of the existing deferred grazing system with the fisheries habitat of Gance Creek;

4. Make recommendations as to the optimum grazing strategies relative to use and protection of the riparian zone;

<u>1982 Objectives:</u>

1. Collection of geomorphic/aquatic, riparian, streamside herbage (not reported here), fish population, and hydrologic data as in previous years;

2. Comparison of these FY 1982 data with that of previous years;

3. Discussion of any habitat condition trends that may be becoming apparent as the data base increases;

4. Discussion of any extraneous factors that may be influencing the fishery system.

<u>1982 Accomplishments:</u>

This report of FY 1982 progress is being submitted as required for inclusion in the overall Saval Project Annual Progress Report and is therefore brief and concentrates on changes in habitat variables over time. An enhanced Livestock-Fisheries Interaction Studies report dealing with the fisheries results obtained to date and more thoroughly covering all years of the project is in preparation.

[1/] Platts, W. S., and R. L. Nelson. 1982. Livestock-Fishery Interaction Studies - Gance Creek, Nevada, Progress Report 4. Unpubl. Rep. on file, USDA For. Serv., Intermt. For. and Range Exp. Stn., For. Sci. Lab., Boise, ID. 94 p.

Approach

The study design of the fisheries phase of this study consisted of the stratification of 1,800 ft of Gance Creek into 181 equidistant stream cross sections, placed at 10-ft intervals along the right streambank, determined by facing upstream, and perpendicular to the main streamflow. This stream section was subdivided into three smaller sections of 600 feet each, the central section was fenced to exclude livestock, and the two external 600-ft sections continued under the existing grazing management of the allotment and served as control sites (Fig. 6.1). At each of the 181 transects, a variety of habitat variables were measured. These variables fall into four fundamental categories and include the following:

Geomorphic/Aquatic

1. Substrate surface materials;
2. Substrate particle embeddedness;
3. Water column width and depth;
4. Instream vegetal cover;
5. Stream shore depth;
6. Pool width, quality, and feature of origin;
7. Riffle width;
8. Streambank angle and undercut;
9. Fisheries habitat quality;
10. Canopy coverage and light intensity;

Riparian

11. Streamside habitat type;
12. Streambank stability;
13. Overhanging vegetal cover;
14. Forage biomass and utilization;
15. Streambank alteration;

Hydrologic

16. Stream profile;
17. Stream gradient and water velocity;

Biological

18. Fish species composition, numbers, biomass, and condition.

Descriptions of the techniques employed can be found in Platts et al.[2/] and in Platts and Nelson[3/].

[2/] Platts, W. S., W. F. Megahan, and G. W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA For. Serv. Gen. Tech. Rep. INT-138, Intermt. For. and Range Exp. Stn., Ogden, UT. 90 p.

[3/] See footnote 1 on page 68.

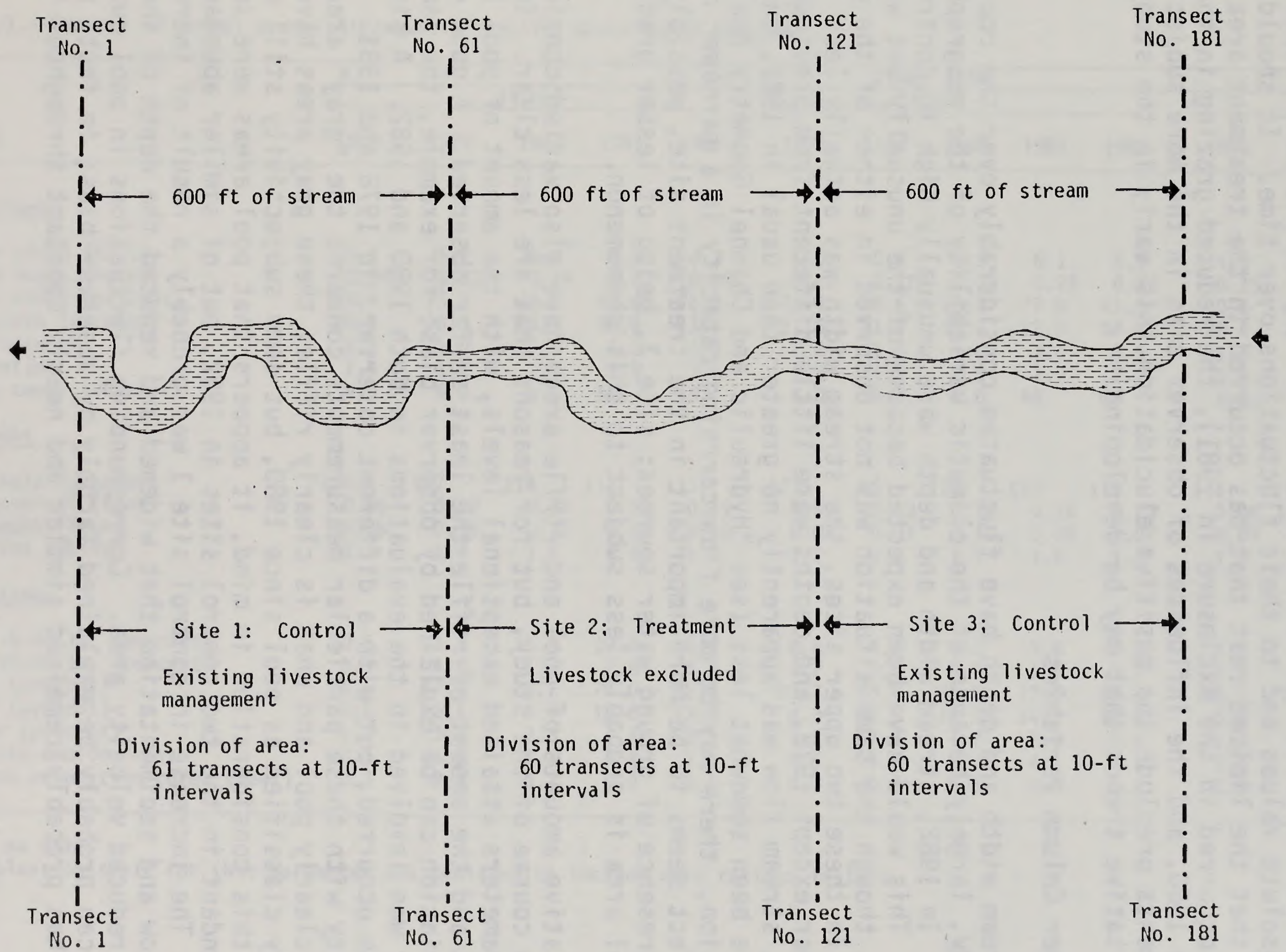


Figure 6.1 Schematic diagram of the livestock-fishery interactions study design on Gance Creek, Nevada.

Results and Discussions

Geomorphic/Aquatic Analysis

Results of the 1982 geomorphic/aquatic analysis are displayed for comparison with previous years' results in Table 6.1. These data indicate little change in structural conditions since 1981, and effects of the above normal precipitation that occurred the previous winter are scarcely discernible. Variables are discussed individually below, with respect both to their absolute values and to their fluctuations over time. It should be borne in mind that the limited rest that has occurred in the treatment area (heavy grazing occurred in the exclosure in 1981), the reduced grazing in the control sites in 1980, and the influences of observer bias in the more subjective measurements preclude the positive elucidation this early in the study of rehabilitative trends that may be developing.

Water Column Variables

Stream width and depth have fluctuated considerably over the course of the study, largely because of the climatic variability of the geographic region. In 1982, stream width and depth were unusually high in control site 1. This would have been expected because of the unusually wet winter of 1981-82, though the same situation was not observed in either of the other two sites. In these two upper sites, the stream width was actually less than any other year except 1978, and depths were little different from previous years. In fact, stream flow was apparently no greater than usual in 1982, and may even have been somewhat less (see "Hydraulic and Channel Geometry Analysis"). In addition, there may be more flow-carrying capacity in a narrower channel. This effect seems to be more important in the treatment site, possibly because of the presence of ground water sources; site 3, being of lesser gradient with more pool area is probably less subject to this phenomenon.

Relative amounts of pool and riffle areas have also varied considerably over the course of the study, but for reasons that are less clear. In 1982, both parameters attained exceptional levels, with the amount of pool being the greatest and the amount of riffle the least so far observed. A good deal of this variation can be explained by observer bias; for example, the same observer was involved in the evaluations in both 1980 and 1982. A similar situation occurred, but with a different observer, in 1978 and 1981. The difficulty with these particular measurements concerns the "gray" area between what is clearly pool and what is clearly riffle; these gray areas have been routinely classified as pool since 1980, but some subjectivity still exists. Bearing this consideration in mind, it appears that pool areas were somewhat more abundant in the two control sites in 1982, but of similar abundance in site 2. The increase in control site 1 was probably a result of increased streamflow and sedimentation that widened and reduced the depth of the channel in this reduced velocity area. Corresponding fluctuations in pool quality ratings can probably be explained largely by observer bias; in fact, pool quality has probably remained similar and nearly constant throughout the study area.

Table 6.1.--Summary of annual geomorphic/aquatic results, Gance Creek, Nevada.

	Study Site														
	Site 1					Site 2					Site 3				
Variable	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982
Water column															
Stream width (feet)	5.1	5.2	6.0	5.9	6.3	6.0	5.6	6.5	6.1	5.9	4.5	5.5	6.4	6.2	5.6
Stream depth (feet)	0.19	0.22	0.24	0.22	0.29	0.22	0.22	0.25	0.22	0.23	0.15	0.19	0.21	0.21	0.21
Riffle width (percent)	69.4	73.7	43.1	60.6	26.4	78.4	78.6	48.3	77.8	41.9	70.6	75.3	53.1	74.1	36.2
Pool width (percent)	30.6	26.3	56.9	38.8	73.6	21.6	21.4	51.7	22.0	58.1	29.4	24.7	46.9	25.9	63.8
Pool feature[2/]	1.2	1.0	1.0	4.2	3.8	1.0	1.0	1.0	3.4	4.6	1.0	1.0	1.0	3.5	4.3
Pool rating	1.9	1.6	2.5	1.9	3.0	1.9	1.8	2.5	1.3	2.3	1.6	1.8	2.2	1.5	2.8
Canopy cover (degrees)	N.D.[1/]	N.D.	N.D.	56	40	N.D.	N.D.	N.D.	48	26	N.D.	N.D.	N.D.	55	38
Streambanks															
Bank angle (degrees)	126	107	114	111	117	123	95	121	127	118	141	114	126	135	122
Bank undercut (feet)	0.06	0.20	0.17	0.22	0.19	0.09	0.33	0.18	0.16	0.23	0.08	0.14	0.14	0.10	0.13
Bank depth (feet)	0.05	0.10	0.12	0.08	0.10	0.04	0.07	0.10	0.05	0.07	0.03	0.04	0.10	0.05	0.06
Fisheries rating	1.1	1.4	1.8	1.6	2.1	1.1	1.6	1.7	1.6	1.7	1.5	1.4	1.7	1.5	1.8
Streambottom															
Fines <0.03 in. (percent)	10.5	11.4	15.9	10.6	6.2	8.6	4.5	9.3	5.6	2.2	1.2	4.7	14.8	9.6	7.1
Fines >0.03 in. (percent)	8.1	4.8	1.7	2.8	5.8	1.7	2.5	2.2	1.0	3.7	7.9	6.5	3.7	5.8	8.6
Gravel (percent)	76.5	67.5	70.7	74.0	72.5	80.3	63.6	66.6	72.0	67.4	86.2	78.3	74.8	80.5	79.0
Rubble (percent)	3.6	13.1	9.4	10.8	13.4	8.3	22.5	14.3	14.1	18.2	3.0	6.3	3.1	1.8	1.7
Boulder (percent)	1.3	3.2	2.3	1.7	2.1	1.1	7.3	7.7	7.3	8.5	1.7	4.3	3.6	2.1	3.6
Substrate embeddedness	3.1	3.5	2.1	3.4	2.4	3.6	4.0	2.7	4.1	3.1	3.8	4.2	3.1	3.9	2.7
Instream vegetation cover (feet)	0.3	0.3	0.2	0.0	0.6	0.1	0.3	0.3	0.0	0.2	0.3	0.6	0.3	0.0	0.4

1/ N.D. - no data.
2/ The evaluation scale for this parameter was modified to include more ratings in 1981.

Too little time has elapsed to evaluate canopy cover at this point, though it does appear that site 2 was the most shaded. This result is not supported by light intensity estimates (Table 6.2), but the latter measurement takes into account more microhabitat influences.

Streambank Variables

Streambank characteristics have also fluctuated some since 1978, probably largely in response to changes in water level. These measurements are less subjective than measurement of the amounts of pool and riffle, but it is still too early to determine trends with any certainty. Streambank angle seems to be the most variable, followed by the amount of undercut. Fluctuations in water level, especially when considered in light of the large-scale changes in channel morphology that are known to occur,[3/] can cause many real and apparent changes in these parameters. None of the streambank variables were much different in 1982 than in 1981, but the limited changes that did occur improved conditions in sites 2 and 3 and reduced them slightly in site 1. These changes in quality are expressed in the changes in fisheries quality rating, except in site 1. The fisheries quality may have been over-rated in site 1 because of the previously discussed problems with pool amount and quality ratings that can also affect the fisheries quality rating.

Streambottom Variables

There has been relatively little change in the proportional amounts of streambottom materials over the course of the study. The biggest changes occurred in site 2 between 1978 and 1979, which was a period of intense channel scouring.[4/] The treatment site continued to possess the fewest fine sediments and, therefore, had the most favorable embeddedness rating. In 1982, in all sites, gravel was the predominant substrate material, followed by rubble in sites 1 and 2 and large fine sediments in site 3. There is nothing in the relative amounts of the various substrate materials to account for the dramatic increase in embeddedness suggested by the data, but the consistency with 1980 embeddedness ratings suggests the same observer bias effect described previously with respect to pool abundance and pool quality. Consequently, intrayear differences between sites are probably realistic, whereas interyear comparisons for this variable must be made with caution. Interestingly, instream vegetation was somewhat more abundant in 1982 than in 1981 throughout the study area, and in site 1 was at the highest level yet observed.

Riparian Analysis

Results of the 1982 riparian analysis are presented for comparison with previous years' data in Table 6.2. The same cautions with respect to data interpretation that were given for geomorphic/aquatic analysis results should also be applied here.

[3/] See footnote 1 on page 68.
[4/] See footnote 1 on page 68.

Table 6.2.--Summary of annual riparian analysis results, Gance Creek, Nevada.

	Study Site														
	Site 1					Site 2					Site 3				
Variable	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982
Habitat type	6.8	12.1	10.4	12.4	15.2	6.1	7.9	10.1	12.1	15.4	12.0	8.5	10.6	10.8	13.5
Bank cover stability	1.3	1.9	2.2	2.1	2.5	1.4	1.6	2.3	2.1	2.9	2.2	1.6	2.2	2.0	2.5
Stream cover	2.7	3.0	1.9	2.4	2.7	2.4	2.5	1.9	1.9	2.5	2.7	2.5	1.8	1.9	2.4
Bank alteration (percent)															
- natural	29	27	32	27	33	30	32	36	30	24	31	29	33	25	27
- artificial	21	14	16	17	13	15	9	0	11	7	19	13	12	15	16
- total	50	41	48	44	46	45	41	36	41	31	50	42	45	40	43
Vegetative overhang (feet)	0.09	0.18	0.07	0.15	0.33	0.14	0.12	0.14	0.13	0.37	0.06	0.08	0.14	0.06	0.28
Vegetation use (percent)	68	73	46	75[1]	55	53	15	>0	>55[1]	1	59	48	42	75	56
Light intensity (percent)	N.D.[2]	N.D.	N.D.	N.D.	37	N.D.	N.D.	N.D.	N.D.	36	N.D.	N.D.	N.D.	N.D.	35

[1] Data provided by Dr. Richard E. Eckert, Jr., Range Scientist, USDA-Agricultural Research Service, Renewable Resources Center, Reno, Nevada.
[2] N.D. - no data.

Several of the riparian analysis variables are among the most subjective in the study. This fact alone probably accounts for most of the increase in habitat type ratings since 1978. This is particularly true since 1978 because a slightly different technique was used to evaluate this parameter then, and it seems unlikely that the habitat has actually improved as much as the data suggest. Intrayear differences between sites are, however, probably quite reliable; there is, therefore, some indication that the treatment site may be in an upward trend, whereas control site 1 could be in a static trend and control site 3 in a downward trend. In any event, 1982 data show sites 1 and 2 to be similar with respect to habitat type, and both were superior to site 3.

The stream cover and bank cover stability ratings show that the streambanks were well vegetated in 1982 and that much of this vegetation was of brush and tree form. The best stability ratings were obtained in the treatment site, which, because this rating appears to correspond well in all sites to grazing intensity, could well be a real response to reduced grazing allowing the development of a better vegetative mat on the streambanks.

Streambank alteration is a difficult parameter to evaluate accurately because of great potential for observer bias. Nevertheless, the amounts of both artificial and natural alteration appears to have remained relatively constant over the course of the study. The very low level of artificial alteration observed in the treatment site in 1980 indicates that none of the alteration therein was definitely attributable to livestock at that time. Since considerable livestock use occurred inside the exclosure in 1981, the artificial alteration level increased dramatically, followed by a reduction in 1982 when cattle were completely excluded. Comparison of total bank alteration (artificial plus natural) suggests that the treatment site streambank is gradually moving toward a more natural condition; to a certain extent, this may also be occurring in the control site 3 because of the fairly low level of use in that site over the course of the study.

Overhanging vegetation was unusually abundant in 1982, possibly as a result of the high precipitation over the winter of 1981-82. There is no apparent trend in this variable over time, and it does not even appear to be directly related to vegetation use. Light intensity, a variable added in 1982, indicates that the treatment site presently receives the greatest sunlight, site 3 the least. It is too soon to evaluate the light intensity measurements because we are still refining the technique.

Hydraulic and Channel Geometry Analysis

A summary of annual hydrologic results is presented in Table 6.3, and cross sectional diagrams of one central transect in site 2 for which we have yearly records are displayed in Figure 6.2 for comparison of annual changes in profile. Cross sectional diagrams of all surveyed transects will be presented in the full Livestock-Fishery Interaction Studies report.[5/]

The most obvious hydrologic feature of Gance Creek was its variability. Inter- and intrayear fluctuations in all parameters, including profiles, were frequently extreme. As expected, stream widths, depths, and cross sectional areas were generally high during the high water years of 1980 and 1982 because of increased flows. This generality broke down somewhat in site 1, where stream depth and area seemed to be high, but possibly less than expected. The great increase in stream width and the decline in gradient suggests that the channel is widening and producing a greater amount of relatively shallow pool areas; this inference is supported by the geomorphic/aquatic analysis results (Table 6.1) and the stream profiles. Site 2 was also somewhat anomalous with respect to stream width because the stream in the area of the hydrologic surveys has become progressively narrower since 1980. This is the result of the large channel profile changes, especially scouring, that occur in this area (Figure 6.1), and produce a narrower, deeper channel. This process first became apparent to us in 1979, for which we unfortunately do not have complete hydrologic data; examination of Table 6.1, however, shows that the stream was also unusually narrow in site 2 in 1979, corroborating the conclusion that this is a very labile stream section.

Fish Population Analysis

Fish population results are presented for time trend evaluation in Table 6.4.

The most striking features of the Humboldt cutthroat trout population in Gance Creek were dramatic fluctuations in population parameters. Abundance characteristics (numbers, biomass, and standing crop), for example have gone from low levels in 1978, through high levels in 1980, to predicted[6/] low levels in 1982; whether the nadir of the down cycle has been reached, however, remains to be seen. This cycle was apparently driven by changes in the proportional abundance of young of the year trout, possibly resulting from competition with or predation by older individuals. Density dependence is suggested by the opposite fluctuation in condition factors.

[5/] Platts, W. S. and R. L. Nelson. In preparation. Livestock-Fishery Interaction Studies - Gance Creek, Nevada, Progress Report 5. USDA For. Serv., Intermt. For. and Range Exp. Stn., For. Sci. Lab, Boise, Id.
[6/] See footnote 1 on page 68.

Table 6.3--Summary of annual hydrologic analysis means, Gance Creek, Nevada.[1/]

	Study Site											
	Site 1				Site 2				Site 3			
Variable[2/]	1978	1980[3/]	1981[4/]	1982[3/]	1978	1980	1981	1982	1978[3/]	1980	1981	1982[5/]
Channel gradient (percent)	4.02	1.46	2.41	1.04	1.57	1.83	2.73	2.04	1.81	2.51	2.29	2.53
Channel resistance (n)	0.20	0.19	0.17	0.08	0.11	0.12	0.10	0.13	0.29	0.37	0.41	0.15
Stream width (ft)	2.75	4.83	4.49	6.50	7.66	8.01	6.09	5.63	4.91	7.83	6.89	9.35
Stream depth (ft)	0.278	0.350	0.235	0.272	0.137	0.259	0.200	0.305	0.184	0.382	0.271	0.285
Cross-sectional Area (ft^2)	0.73	1.84	1.04	1.72	1.03	1.91	1.16	1.67	0.99	3.05	1.96	2.86
Hydraulic radius	0.228	0.316	0.220	0.253	0.134	0.244	0.192	0.295	0.181	0.348	0.258	0.281
Velocity (ft/sec)	0.69	0.72	0.83	0.87	0.41	0.76	0.84	0.96	0.49	0.72	0.39	0.89
Flow (ft^2/sec)	0.40	1.03	0.75	1.32	0.39	1.32	0.95	1.40	0.33	1.51	0.62	2.12
Stream power	0.43	0.21	0.26	0.14	0.06	0.25	0.13	0.35	0.09	0.31	0.19	0.36

1/ Four transects were surveyed in site 2 in 1979, but they are used only for profile comparison.
2/ Mean values for wetted stream channel.
3/ Only 9 transects surveyed.
4/ Only 8 transects surveyed.
5/ Only 6 transects surveyed.

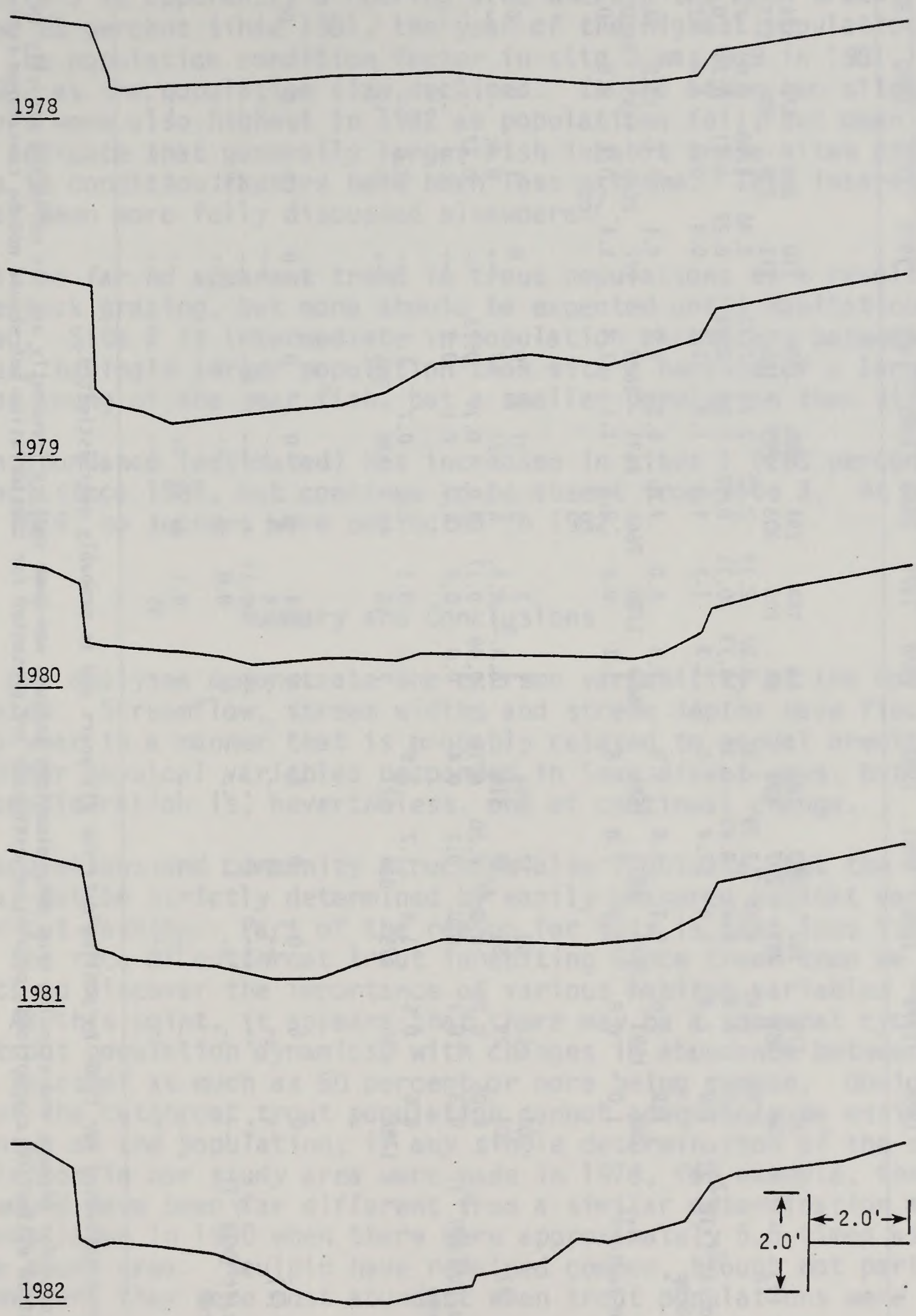


Figure 6.2. Annual fluctuations in stream channel profile at transect 90.

Table 6.4--Summary of annual fish population results, Gance Creek, Nevada.

Variable	Site 1 1978	Site 1 1979	Site 1 1980	Site 1 1981	Site 1 1982	Site 2 1978	Site 2 1979	Site 2 1980	Site 2 1981	Site 2 1982	Site 3 1978	Site 3 1979	Site 3 1980	Site 3 1981	Site 3 1982
Cutthroat Trout															
Total catch (#)	32	175	303	203	183	64	184	294	288	170	110	216	472	524	126
Population estimate (#)	32	181	327	207	191	64	203	303	299	185	111	235	506	533	143
Mean length (in)	4.47	2.42	2.66	3.39	2.87	3.57	2.19	2.82	2.73	2.72	2.46	1.98	2.09	2.56	2.62
Mean weight (oz)	0.97	0.39	0.41	0.40	0.31	0.73	0.31	0.52	0.23	0.24	0.22	0.11	0.26	0.17	0.18
Estimated biomass (oz/ft^2[x10^{-2}])	1.0	2.3	3.8	2.4	1.6	1.3	1.9	4.0	1.9	1.2	0.9	0.8	3.4	2.5	0.8
Estimated standing crop															
(#/ft^2[x10^{-2}])	1.0	5.8	9.1	5.8	5.0	1.8	6.0	7.8	8.2	5.2	4.1	7.1	13.2	14.3	4.3
(#/mile)	282	1593	2878	1822	1681	563	1786	2666	2631	1628	977	2068	4453	4690	1258
Population condition factor[1]	1.0	0.8	0.9	1.0	1.5	1.1	0.8	0.9	1.1	1.4	1.4	0.7	0.9	0.9	1.4
Sculpin[2]															
Total catch (#)	203	17	53	37	94	1	2	5	27	29	0	1	0	0	0
Population estimate (#)	203	29	54	38	115	N.A.[3]	N.A.	5	27	47	--	N.A.	--	--	--
Mean weight (oz)	0.05	0.20	N.D.[4]	0.20	0.16	0.49	0.17	N.D.	0.17	0.23	--	0.27	--	--	--
Observed biomass (oz/ft^2[x10^{-2}])	0.3	0.1	N.D.	0.2	0.4	0.0	0.0	N.D.	0.1	0.2	--	0.0	--	--	--
Observed standing crop															
(#/ft^2[x10^{-2}])	6.6	0.5	1.4	1.2	2.5	0.0	0.1	0.1	0.7	1.3	--	0.0	--	--	--
(#/mile)	1786	255	475	334	827	9	18	44	238	255	--	9	--	--	--
Sucker[2]															
Total catch (#)	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Population estimate (#)	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--
Mean weight (oz)	--	--	--	--	--	--	0.17	--	--	--	--	--	--	--	--
Observed biomass (oz/ft^2[x10^{-2}])	--	--	--	--	--	--	0.0	--	--	--	--	--	--	--	--
Observed standing crop															
(#/ft^2[x10^{-2}])	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--
(#/mile)	--	--	--	--	--	--	35	--	--	--	--	--	--	--	--

[1] This variable had to be estimated for 1980 by pooling data for all years and is probably over estimated.

[2] Total catch figures used for biomass and standing crop determinations because non-game species frequently are not collected strictly in accordance with population estimation assemptions; population estimates are presented for consideration but should not be considered reliable.

[3] N.A. - not available; capture pattern did not fit model closely enough to obtain even a poor estimate and/or total catch was zero.

[4] N.D. - no data; non-game species were not weighed in 1980.

Population fluctuations are best illustrated by the changes in control site 3, which suffered the largest reduction in population size in 1982 (73 percent). Site 3 is apparently a rearing area wherein the mean trout length has increased 25 percent since 1981, the year of the highest population in that site. The population condition factor in site 3 was 0.9 in 1981, climbing to 1.4 in 1982 as the population size declined. In the other two sites, condition factors were also highest in 1982 as populations fell, but mean lengths and weights indicate that generally larger fish inhabit these sites and the fluctuations in condition factors have been less extreme. This interesting situation has been more fully discussed elsewhere[8/].

There is so far no apparent trend in trout populations as a result of reduced livestock grazing, but none should be expected until habitat conditions have improved. Site 2 is intermediate in population parameters between the control sites, having a larger population than site 1 because of a larger proportion of young of the year fish, but a smaller population than site 3.

Sculpin abundance (estimated) has increased in sites 1 (203 percent) and 2 (77 percent) since 1981, but continue to be absent from site 3. As in all years since 1979, no suckers were collected in 1982.

Summary and Conclusions

All of our analyses demonstrate the extreme variability of the Gance Creek ecosystem. Streamflow, stream widths and stream depths have fluctuated from year to year in a manner that is probably related to annual precipitation patterns. Other physical variables responded in less direct ways, but the overriding consideration is, nevertheless, one of continual change.

Fish populations and community structure also fluctuate, but the driving mechanism may not be strictly determined by easily measured habitat variables in any clear-cut fashion. Part of the reason for this is that less is really known about the race of cutthroat trout inhabiting Gance Creek than we would like; efforts to discover the importance of various habitat variables is just beginning. At this point, it appears that there may be a somewhat cyclic pattern to trout population dynamics, with changes in abundance between 2 consecutive years of as much as 50 percent or more being common. Obviously, the status of the cutthroat trout population cannot adequately be estimated by a single census of the population; if any single determination of the status of the population in our study area were made in 1978, for example, the conclusion would have been far different from a similar determination made only 2 years later in 1980 when there were approximately 5.5 times as many trout in the study area. Sculpin have remained common, though not particularly abundant; however, they were most abundant when trout populations were low.

8/ Platts, W. S. and R. L. Nelson. 1983. Population fluctuations and genetic differentiation in the Humboldt cutthroat trout of Gance Creek, Nevada. In: Proc. Cal-Neva Chapter Amer. Fish. Soc. 14 p.

Unfortunately, few conclusions can be drawn about the value of the livestock exclosure by comparing the three study sites in the study areas. Grazing inside the exclosure plus the unstable nature of the ecosystem have prevented any definite habitat improvement to occur inside the exclosure. We believe that livestock-induced deterioration of the watershed as a whole and low beaver populations, which have exacerbated the natural geoclimatic variability of the region, and the small size of the protected stream area inside the exclosure prevent the control of offsite influences that act as trout population limiting factors throughout the study area.

In conclusion, it is likely that trout populations maintain themselves at levels below those they could obtain in more favorable habitats. Fencing of such stream sections, however, will probably not change this situation materially because of general watershed deterioration. Fortunately, the native cutthroat trout appear sufficiently resilient to survive the unstable conditions. Although the small size of the exclosure may limit evaluation of fisheries response to management changes, it will allow evaluation of critical habitat changes, especially in the riparian zone, under grazed and rested conditions. If we can accomplish this with a small annual budget, funding will have been well spent.

CHAPTER 7

HYDROLOGY RESEARCH

Steven A. Loomis and Keith R. Cooley

1982 Objectives:

1. Reduce backlog of precipitation and climate data, and enter into computer data base.

2. Develop storm amount and rainfall erosivity curves as a function of time of year.

3. Evaluate Universal Soil Loss Equation using rainfall simulation.

4. Develop relationships for streamflow and sediment yield at various stream sampling stations.

5. Evaluate runoff and sediment yield from small instrumented basins as a function of site soil and vegetation characteristics.

6. Instrument four small low-elevation watersheds for runoff measurement.

1982 Accomplishments:

1. Precipitation data collection and analysis continued in conjunction with University of Nevada, Reno (UNR) and Agricultural Research Service, Boise (ARS) personnel.

2. A rainfall simulation study utilizing an ARS rotating-boom simulator was conducted on one range site to test the applicability of the Universal Soil Loss Equation.

3. Main channel streamflow measurements and sediment sampling were conducted by UNR and BLM personnel at several sites.

4. Four small basins in the Native Control, Lower Mahala, and Lower Sheep pastures were selected and instrumented for ongoing runoff measurements.

5. Runoff and sediment measurements were made on two small basins on the eastern flank of the South Independence Forest Service pasture. Vegetation production, cover, and frequency measurements were made on the major range sites within the basins.

6. Soil moisture measuring equipment was installed at several sites within the study area.

7. The Ekalaka Rangeland Hydrology and Yield Model was applied to vegetation production data from an exclosure south of the Saval Ranch.

8. An intensive soil survey was completed on approximately 5,000 acres within the Lower and Middle Mahala Creek pastures.

Precipitation

For use in upland soil erosion estimates, an index has been developed which relates the depth and intensity of a storm event to the capacity of the event

to erode soil. The EI index is used in the Universal Soil Loss Equation (Wischmeier and Smith, 1978) to account for rainfall energy effects on soil loss, considering all other factors such as vegetation, soils, and topography, to be equal.

A plot of the cumulative EI index for each of 3 years at climate station no. 4 is presented in Figure 7.1. As can be seen, the curves vary from year to year, depending on when the most erosive storms occur. The event of September 18 produced 23 percent of the total 1982 annual EI value. If the Universal Soil Loss Equation (USLE) was applied on a per-storm basis, 23 percent of the total 1982 upland soil erosion for a given site near climate station 4 would be predicted to occur from this storm event. The USLE applied strictly does not infer what proportion of the eroded soil actually reaches a stream channel. Many other assumptions and limitations must be recognized when applying the USLE on either a storm event or annual basis.

Over a number of years characteristic curves of EI index as a function of season can be developed for an area. This information can be used in planning for optimal timing of range improvements such as vegetation manipulation. Ideally, it would be desirable to maintain sufficient vegetation cover on-site during the season when the most highly erosive storms occur. The EI curves can also be used as an index to relative upland soil loss within the Saval Integration model. The curves can be developed for each climate station, and thus related to elevation.

The rainfall energy factor (R) as used in the USLE on an annual basis is the sum of the individual storm EI index values for the given year. The R factor values at climate station no. 4 for the years 1980, 1981, and 1982 were 19.8, 14.6, and 23.5, respectively (Figure 7.1). The long-term average annual R factor value can be determined for an area from the average of the yearly sum of EI values calculated for the area. Maps of isoerodents (lines of equal R factor value) are available for most of the United States, from which values applicable to a broad area can be selected.

Rainfall Simulation

The USLE was developed from data generally measured in agricultural situations east of the Rocky Mountains. The equation is generally used to predict average soil loss on an annual basis as a function of several site characteristics, as follows:

$$A = (R)(K)(L)(S)(C)(P)$$

where:

A = average annual soil loss in tons/acre
R = rainfall energy factor
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cropping management factor
P = support practice factor

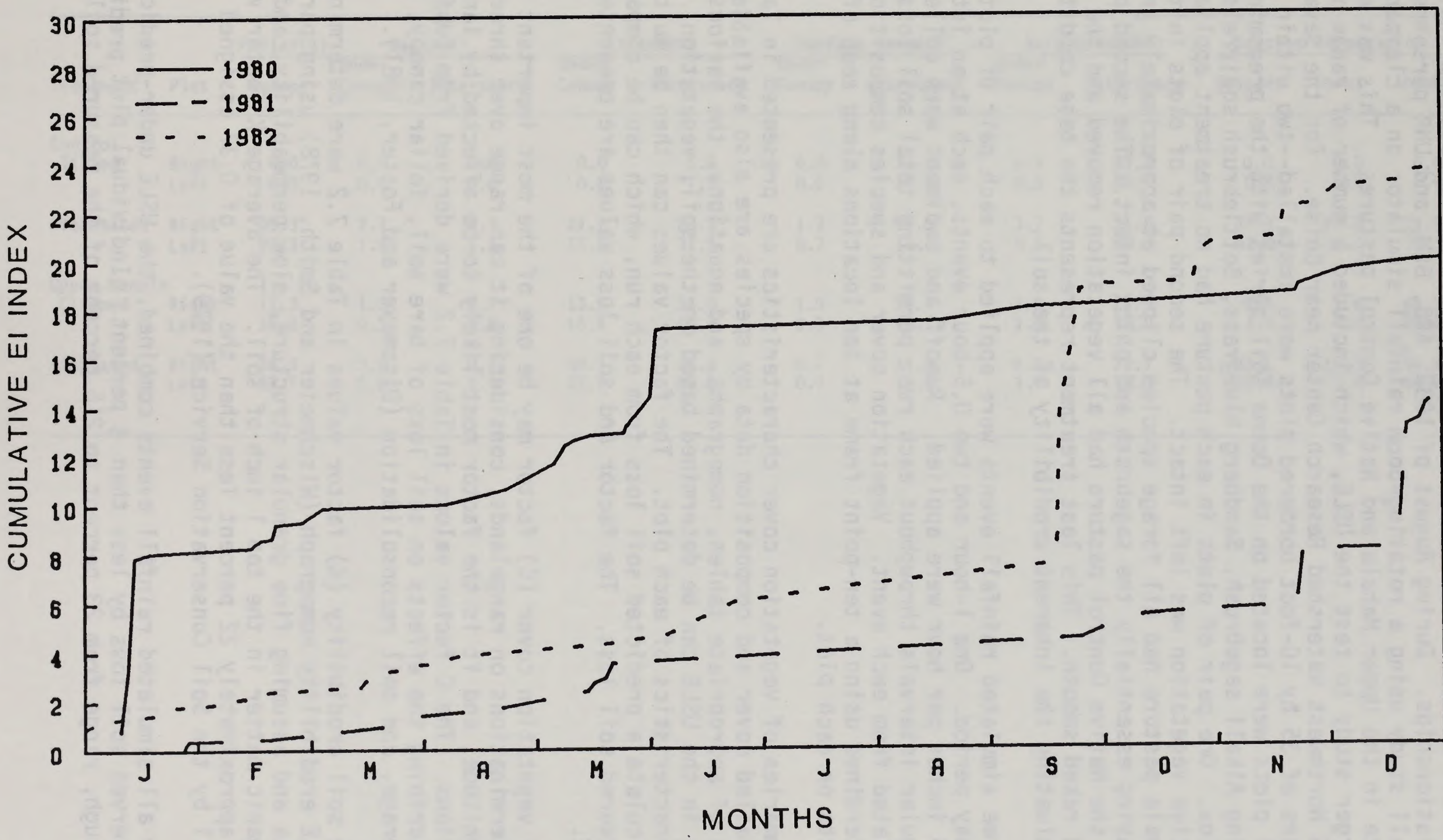


Figure 7.1. Cumulative EI index as a function of time at climate station 4 for 1980 through 1982.

Rainfall simulation has been used extensively to improve the individual factor relationships. During August of 1982, ARS, BLM, and UNR personnel conducted a small study using a rotating-boom rainfall simulator on a claypan 8-10" range site in the Upper Mahala and Native Control pastures. This was a part of a larger study to test the USLE, which included a number of range sites at the ARS Northwest Watershed Research Center near Boise. For the Saval study four pairs of 35 by 10-foot bordered plots were installed--two within each pasture. All plots were located on the Donna soil series with the predominant vegetation being Alkali sagebrush, Sandberg bluegrass, Bottlebrush squirreltail, and phlox. One pair of plots in each pasture had no treatment applied, thus the native vegetation was left intact. The second pair of plots in the Upper Mahala pasture had all forage species clipped at approximately ground level. leaving essentially the sagebrush and phlox intact. The second pair of plots in the Native Control pasture had all vegetation removed and the soil tilled and raked smooth. This last treatment represents the base condition for evaluating the inherent erodibility of the soil.

Three simulated rainfall events were applied to each pair of plots over a 2-day period. One 1-hour and two 0.5-hour events, each at an intensity of 2.5 inches per hour were applied. Runoff and sediment were collected at regular intervals throughout each run, permitting total soil loss to be calculated from each event. Vegetation cover and species composition were determined using a ten-point frame at ten locations along each of three transects on each plot.

Summaries of vegetation cover characteristics are presented in Table 7.1. Detailed cover and composition data by species are also available. Through the use of appropriate tables, nomographs, and equations, the various factor values in the USLE can be determined based on the soil, vegetation, and topographic characteristics of each plot. The factor values can then be multiplied to calculate a predicted soil loss from each run, which can be compared to the measured soil loss. The factor and soil loss values are presented in Table 7.2.

The vegetation cover (C) factor may be one of the most important for soil loss determinations on rangelands, considering it can range over three orders of magnitude, and it is the factor most likely to be affected by land management actions. The C factor values in Table 7.2 were derived from subfactors describing the effects on soil loss of bare soil, foliar canopy, depression storage, and soil reconsolidation (Dissmeyer and Foster, 1981).

The soil erodibility (K) factor values in Table 7.2 were determined from the USLE erodibility nomograph (Wischmeier and Smith, 1978) using particle size data and assuming fine granular structure, slow permeability, and 1.5 percent organic matter in the top 1 inch of soil. The average K factor value of 0.29 is approximately 22 percent less than the value of 0.37 assigned to the Donna soil by the Soil Conservation Service (1979).

For all simulated rainfall events combined, the USLE under-predicted the observed soil loss by less than 5 percent. Individual plot predictions though, range from 23 percent to 215 percent of the measured soil loss.

Table 7.1. Vegetation characteristics of rainfall simulation plots.

		Foliar(%)	Basal(%)		Litter(%)		Surface Rock(%)		Bare Ground(%)		Species Composition		
Treatment	Plot	Canopy	Under Canopy	Interspace	Under Canopy	Interspace	Under Canopy	Interspace	Under Canopy	Interspace	Grasses	Forbs	Shrubs
Control													
Tilled	Right	0.0	0.0	0.0	0.0	5.0	0.0	11.7	0.0	83.3	0.0	0.0	0.0
	Left	0.0	0.0	0.0	0.0	7.3	0.0	10.0	0.0	82.7	0.0	0.0	0.0
Vegetated	Right	35.3	2.7	0.3	27.7	23.3	1.3	10.0	3.7	31.0	37.3	23.8	38.9
	Left	23.3	1.4	1.3	15.6	31.7	0.7	13.0	5.6	30.7	47.0	16.5	36.5
Upper Mahala													
Clipped	Right	17.3	1.3	2.7	13.0	34.0	1.0	21.7	2.0	24.3	9.4	1.6	89.1
	Left	18.0	0.3	2.0	16.4	40.3	0.3	13.7	1.0	26.0	7.5	0.0	92.5
Vegetated	Right	36.3	3.0	0.7	30.7	26.3	0.7	14.0	2.0	22.7	32.1	15.3	52.6
	Left	37.7	2.6	3.7	32.7	28.0	0.7	14.3	1.7	16.3	26.4	5.0	68.6

Table 7.2. USLE factor values, measured, and predicted plot soil loss.

Treatment	Run[a]	Plot[b]	Rainfall (inches)	R[c]	Slope (%)	LS[d]	K	C	Soil Loss (tons/acre) Measured	Predicted
Control										
Tilled	D	R	2.33	43.4	3.9	0.254	0.332	0.663	1.129	2.426
		L	2.21	38.7	3.9	0.254	0.254	0.654	0.783	1.633
	W	R	1.21	23.5					1.438	1.314
		L	1.16	21.5					1.079	0.907
	VW	R	1.12	19.9					2.119	1.113
		L	1.08	18.4					1.429	0.776
Vegetated	D	R	2.14	36.7	3.7	0.241	0.253	0.056	0.216	0.125
		L	2.30	42.8	3.7	0.241	0.253	0.058	0.117	0.151
	W	R	1.17	22.0					0.153	0.078
		L	1.21	23.6					0.098	0.081
	VW	R	1.01	16.8					0.169	0.057
		L	1.05	18.3					0.097	0.065
Upper Mahala										
Clipped	D	R	2.33	43.4	3.5	0.229	0.272	0.042	0.015	0.114
		L	2.21	38.7	3.6	0.235	0.272	0.044	0.126	0.109
	W	R	1.19	22.7					0.032	0.059
		L	1.18	22.3					0.102	0.063
	VW	R	1.12	19.9					0.059	0.052
		L	1.01	16.0					0.129	0.045
Vegetated										
	D	R	2.08	36.1	3.5	0.229	0.335	0.040	0.089	0.111
		L	2.19	40.4	3.0	0.199	0.335	0.029	0.182	0.078
	W	R	1.20	23.2					0.065	0.071
		L	1.20	23.2					0.125	0.045
	VW	R	1.13	20.3					0.103	0.062
		L	1.06	17.7					0.147	0.034

[a] The codes D, W, and VW represent dry, wet, and very wet antecedent moisture conditions, respectively.

[b] The codes R and L denote right and left plots, respectively.

[c] R is calculated as the maximum 30-minute intensity times E/100, where $E = 916 + 331 [\log_{10}(\text{intensity})]$.

[d] $LS = (\lambda/72.6)^m (65.41 \sin^2 \theta + 4.56 \sin \theta + 0.065)$ in which, λ is slope length in feet, θ is angle of slope, and m is 0.4 on the slopes of 3.5 percent or greater, and 0.3 on the 3.0 percent slope.

Runoff and Sediment

In March of 1982 the operation of the surface water gaging stations located at the highway on Gance and Mahala Creeks was transferred from the U. S. Geological Survey (USGS) to Saval Project personnel. The two stations on Gance and Mahala Creeks near the FS-BLM boundary are still operated and maintained by the USGS with BLM funding. The daily data from these stations during the period of operation by the USGS were not available for inclusion in this report, thus annual runoff volumes cannot be determined. Peak streamflow values were calculated from the raw data forms, and are presented in Table 7.3.

The streamflow data from the lower stations since March of 1982 are not available at this time for analysis. Several problems were encountered, including freezing of water in the stilling wells, sediment plugging the well intakes, recorder operations, and personnel changes. Inspection, correction, and digitizing of the charts is ongoing. Peak flow values were determined for each station, and are presented in Table 7.3.

The precipitation and peak streamflows were generally higher on all basins during the 1982 water year, compared to the previous 2 years. The 1982 peak flow of 100 cfs on Lower Mahala equals the largest annual peak for the previous 16 years. This is in comparison to the 1981 peak flow of 1.7 cfs which was the lowest value for the period of record. The total annual precipitation on the basin for the 1982 water year was almost 2.5 times the 1981 total.

An estimate of the amount of time that streamflow is above or below a given value is potentially useful for irrigation scheduling for optimum meadow production. The flow-duration curves for Upper Gance and Mahala Creeks are presented in Figure 7.2. The flow-duration curve combined with a relationship between discharge and sediment concentration allows a sediment load-duration curve to be developed for a station. An example sediment load-duration curve for the Upper Gance Creek gaging station is presented in Figure 7.3. The flow-duration curves must be used with caution, as they were developed from only 2 years of streamflow data.

Flow-duration and sediment load-duration curves are potentially useful within the context of the Saval Integration Model. These types of curves can be used as functions in the model or as a check against which model-generated flows and sediment loads can be compared.

Runoff and sediment load calculations were made for all stream sampling points, but the data are not presented here. Effects of the channel cutting on Mahala Creek and the vegetation manipulation in the Lower Sheep Creek pasture can be investigated using the stream sampling data.

Small Watershed Installations

Four small watersheds were instrumented within the Native Control, Lower Mahala, and Lower Sheep pastures. The structures in the Native Control and Lower Mahala pastures consist of wooden 8 by 12-foot insulated shelters with H-flume and approach boxes. Recorders mounted in each shelter record the water level passing through the H-flume, which can then be converted to a discharge by means of a rating curve. Two smaller drop-box V-notch weir type

Table 7.3. Annual precipitation and runoff characteristics at four gaging stations on Gance and Mahala Creeks.

Location	Drainage Area (mi^2)	Runoff: Volume (Acre-ft)	Runoff: Volume (in)	Runoff: Peak Flow (cfs)	Runoff: Peak Flow (cfs/mi^2)	Precipitation (in)	Date of Peak Flow
Gance Creek near FS-BLM boundary	6.04						
1980		4523	14.04	60	9.93	26.40	4-22
1981		1865	5.79	8.8	1.46	15.90	5-1
1982				50-60[a]	-[a]	34.58	5-[a]
Gance Creek at Highway 225	19.23						
1980		2984	2.91	53	2.76	19.81	4-24
1981		472	0.46	3.6	0.19	10.88	2-15
1982				67.5	3.51	26.00	5-4
Mahala Creek near FS-BLM boundary	4.18						
1980		1048	4.70	16	3.83	26.34	4-20
1981		109	0.49	1.8	0.43	15.78	4-26
1982				42.5	10.17	31.92	5-20
Mahala Creek at Highway 225	22.57						
1980		1974	1.64	28	1.24	18.02	4-22
1981		36	0.03	1.7	0.08	9.76	3-27
1982				99.7	4.42	23.51	5-18

[a] Recorder malfunctioned, so exact discharge and date of peak are not known. Slope-area method was used to make estimate of the peak discharge

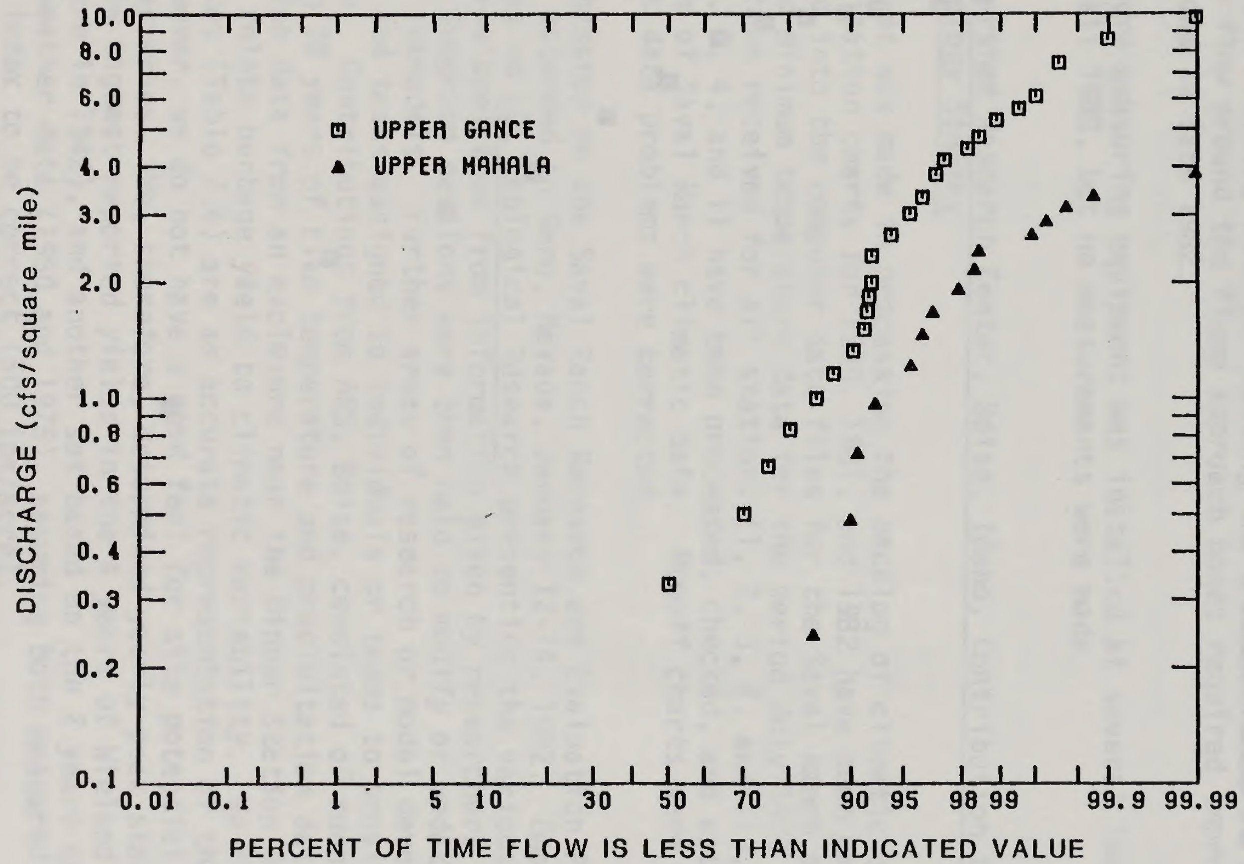


Figure 7.2. Flow - duration curves for Upper Gance and Upper Mahala Creek gaging stations.

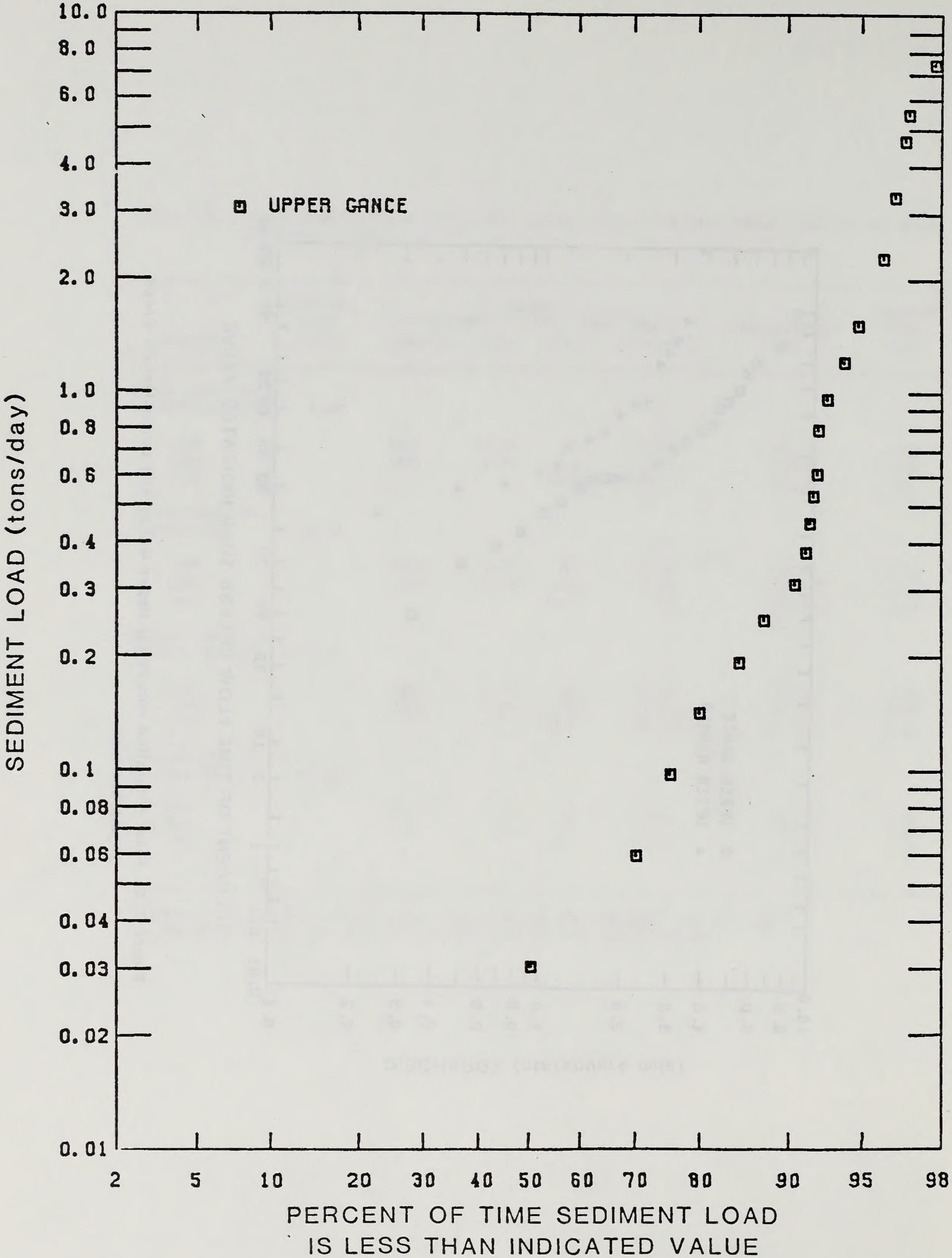


Figure 7.3. Sediment load - duration curve for Upper Gance Creek gaging station.

structures were installed on adjacent watersheds in the Lower Sheep pasture. The water level passing through the V-notch can be related to the discharge by means of a rating curve. No flow was measured from these four structures in the fall of 1982.

Runoff data are still being analyzed from the two H-flume structures previously installed in the South Independence Forest Service pasture. Significant stilling well freezing occurred causing the probable loss of some flow data. Subsurface flow around the flume approach boxes required improved cutoff wall installations in late 1982.

Soil moisture measuring equipment was installed at several locations on the ranch in fall 1982, but no measurements were made.

ARS NW Watershed Research Center, Boise, Idaho, Contribution to Saval Hydrology and Climatology Studies

Good progress was made in processing the backlog of climatic data during 1982. All precipitation charts for 1980, 1981, and 1982 have been marked, digitized, and entered into the computer data files for the Saval Ranch project. Daily maximum and minimum temperature data for the period July 1979 through December 1982 have been received for all stations (1, 2, 3, 4, and 11), and data from stations 2, 3, 4, and 11 have been processed, checked, and entered into the master file of Saval Ranch climatic data. Runoff charts were marked after significant data problems were corrected.

A second workshop on the Saval Ranch Research and Evaluation Project modeling effort was attended in Reno, Nevada, January 12-14, 1982. Emphasis at this workshop was on LGL Ecological Research presenting the various submodels as they had developed them from information given by researchers at the first workshop. Subgroup sessions were then held to modify or update and debug individual submodels. Further areas of research or model development were identified and tasks assigned to individuals or teams to provide needed information. Contributions from ARS, Boise, consisted of running Wight's ERHYM model using 28 years of Elko temperature and precipitation data, and 2 years of vegetation data from an exclosure near the Dinner Station Ranch, in an attempt to relate herbage yield to climatic variability. We feel the series of yield indexes (Table 7.4) are an accurate representation of the relative yields; however, we do not have a good feel for site potential with the existing varieties. We, therefore, determined yearly peak standing crop values based on the highest reported yields in the 4 years of Wieland data (649 lbs/acre in 1942), and another set based on the 2 years containing both yield and weather data (1960 and 1975), assuming both measured yield and the calculated index to be correct (500 lbs/acre).

During the week of September 20-24, 1982, three ARS employees from Boise traveled to the Saval Ranch to clean and calibrate raingages, train the new hydrologic technician at Saval, and help install cut-off walls and stilling wells on all unfinished small watershed sites. All raingages were disassembled cleaned, reassembled, and calibrated in the laboratory and then reinstalled in the field and recalibrated. The Saval hydrologic technician was trained in all aspects of this procedure, which should be conducted annually, and also given instruction on normal field servicing and maintenance during

Table 7.4. Long-term peak standing yield predictions for Saval Ranch based on Elko weather and Wieland vegetation and soil data.

Year	Yield Index	Peak Standing Crop (lbs/ac) Potential (649 lbs/ac)	Observed	Potential (500 lbs/ac)	Elko Annual Precipitation (in)
1953	.59	383	-	295	7.04
1954	.52	337	-	260	6.58
1955	.53	344	-	265	9.52
1956	.88	571	-	440	10.04
1957	.90	584	-	450	10.10
1958	.44	286	-	220	6.40
1959	.11	71	-	55	5.51
1960	.28	182	127	140	7.84
1961	.17	110	-	85	7.60
1962	.88	571	-	440	8.24
1963	.98	636	-	490	15.03
1964	.97	629	-	485	12.14
1965	.78	506	-	390	11.17
1966	.46	298	-	230	6.50
1967	.68	441	-	340	8.62
1968	.77	500	-	385	14.63
1969	.46	298	-	230	7.85
1970	.70	454	-	350	14.56
1971	1.00	649	-	500	13.67
1972	.65	422	-	325	7.29
1973	.51	331	-	255	9.10
1974	.48	311	-	240	4.77
1975	.71	461	354	355	11.34
1976	.33	214	-	165	7.10
1977	.02	13	-	10	6.46
1978	.50	324	-	250	11.14
1979	.41	266	-	205	7.74
1980	.98	636	-	490	12.81
28 Year Average	.60	387	-	300	9.31

this time. Sheet-metal cutoff walls were reinstalled at four of the small watershed sites to reduce flow losses at the measuring flumes.

LITERATURE CITED

Dissmeyer, G. E., and G. R. Foster. 1981. Estimating the cover-management factor in the universal soil loss equation for forest conditions. Journal of Soil and Water Conservation, 36(4): 235-240.

Soil Conservation Service. 1979. Advance Soil Survey Data, Elko County, Nevada, North Central Part, Saval Planning Unit. U. S. Department of Agriculture.

Wischmeier, W. H., and D. D. Smith. 1978. Predicting rainfall erosion losses - a guide to conservation planning. U. S. Department of Agriculture, Agriculture Handbook 537.

LIST OF PUBLICATIONS

Johnson, C. W., M. R. Savabi, and S. A. Loomis. 1983. Rangeland Erosion Measurements for the USLE. (To be presented at the 1983 Summer Meeting, American Society of Agricultural Engineers, Bozeman).

ACKNOWLEDGEMENTS

The authors express their appreciation to John Barber and Neil Hutten of the University of Nevada-Reno for their data collection efforts. Thanks also to Terry Dailey, BLM-Elko District Office for his assistance in equipment installations, and Kenneth Gray and Diane Ballode for their assistance in field data collection.

CHAPTER 8

LIVESTOCK RESEARCH

Lynn K. Winer and Charles F. Speth

An Evaluation of Cattle Production Factors

1982 Objective:

Evaluate some economically important animal production factors on the Saval Ranch.

1982 Accomplishments:

The goal of a cow-calf ranch operation is to maximize the yearly pounds of beef weaned. Reproduction performance of the cow and rate of gain of the calf are two factors important in attaining this goal.

Reproductive performance of the cow is currently monitored by percent conception and percent calf crop weaned. A pregnancy test, by rectal palpation, is performed on each cow and percent conception is determined:

$$\text{Percent Conception} = \frac{\text{pregnant cows}}{\text{total cows exposed}} \times 100$$

The conception rate reported by the Saval Ranch manager in October 1982 was 68%. Pregnancy testing is a useful tool for the ranch manager and for the researcher. It can be used to determine which cows should be kept in the herd or sold, and also to give an early indication of any reproductive problems in the herd.

Percent calf crop weaned is perhaps the most important indication of herd performance. It not only indicates reproductive performance but also calving and mothering ability of the cow. Calf crop weaned is usually based on the number of calves weaned as a percentage of total cows exposed to bulls. Using this definition, the Saval Ranch cows produced a 59% calf crop weaned for 1982. This is a misleading value when there is an extended calving season such as is currently found at the Saval Ranch. The length of a calving season becomes too long or extended when calves are born late enough to cause either light weaning weights or animals that are too young to wean. The extended calving season at the Saval Ranch resulted in 294 calves too young for weaning in October. If percent calf crop is calculated to include these young calves, the value would be raised from 59 to 85% for 1982.

The discrepancy between 59 and 85% calf crop demonstrates the significance of length of calving season. An extended calving season is costly to the ranch owner through loss of sales and added labor, and is an indication of poor herd health. For these reasons, future livestock research will monitor length of calving season.

Feeding low quality hay just prior to and following calving could partly explain the low reproductive performance of the herd. However, extended calving season, low percent conception, and low percent calf crop weaned are more likely due to disease within the herd. Veterinarians have tested the herd for disease and have tested hay and mineral supplements for quality. Results are not yet definitive, but do suggest a disease problem and the need

for periodic mineral supplementation as well as for protein and/or energy supplementation at the start of lactation. Additional tests are needed to more precisely determine the extent of the problem.

Sale of 391 open cows and 284 late calving cow-calf pairs during 1982 should tremendously improve livestock performance on the Saval Ranch. However, in order to attain and sustain a high performance herd, the following steps must be taken: 1) evaluate bull semen, 2) shorten the breeding season, 3) treat infectious disease, 4) provide nutritional supplementation at critical times, and 5) sell low producing animals.

As previously mentioned, reproductive performance of the herd will affect the number of calves at weaning. The number of calves at weaning along with their weight and market price will ultimately determine the success of a cow-calf ranch operation. Typically, calves are weaned and weighed the same day or succession of days regardless of their age. To remove this age effect, weaning weights are adjusted to a standard age, most commonly 205 days. In order to do this, birth date and weight for a sample of calves born, and weaning weight must be known.

During March 1982, 27 female and 34 male calves were eartagged, weighed, and birth dates recorded. Respective birth weights for the two groups were 69 and 70 pounds (Table 8.1). There was no significant difference in birth weight between sexes.

Calves were again weighed at weaning (October 13-15, 1982). The mean weight for sampled heifer calves (N=24) was 423 pounds compared to 433 pounds for Ralgro-implanted steer calves (N=28). The mean weight for the entire Saval Ranch weaned calf crop reported by the ranch manager in October was 403 pounds. The older age of the sampled calves would explain their heavier weights when compared to the entire weaned calf crop. The 1982 weaning weights from sampled calves showed no significant difference between sexes. These results concurred with the previous 2 year's data. Sampled calves weaned this year were significantly (P .01) heavier than sampled weaned calves in both 1980 and 1981. Heavier weights could be partly due to the older age of the 1982 sampled calves. Calf birth dates were unknown for 1980 and 1981. Since these calves were not identified until May they could have been as much as 60 days younger when they were weighed at weaning than were the 1982 calves.

The procedure for determining weaning weights adjusted to a standard 205 days was:

$$\text{Computed 205-day weight} = \text{Average daily gain} \times 205 + \text{Birth weight}$$

where

$$\text{Average daily gain} = \frac{\text{Actual weaning weight - Birth weight}}{\text{Age of calf in days}}$$

Table 8.1. Calf production factors on the Saval Ranch for 1980 through 1982.

Production factor	Sex[1]	1980 N[2]	1980 $\overline{X}$[3]	1981 N	1981 $\overline{X}$	1982 N	1982 $\overline{X}$
Birth weight (lbs.)	Female		-		-	27	69
	Male		-		-	34	70
	Combined		-		-	61	70
Actual weaning weight (lbs.)	Female	25	373	49	338	24	423
	Male	24	384	48	339	28	433
	Combined	49	378[a]	97	338[b]	52	428[c]
Average daily gain (lbs.)	Female	25	1.52	49	1.39	24	1.66
	Male	24	1.60	48	1.32	28	1.70
	Combined	49	1.56[a]	97	1.36[b]	52	1.68[c]
205-day computed weaning weight (lbs.)	Female		-		-	24	409
	Male		-		-	28	420
	Combined		-		-	52	415

1 Mean values were not significant between sexes within years.

2 N = number of calves.

3 $\overline{X}$ = mean value.

abc Mean values in same row with different subscripts are significantly different ($P < .05$).

Average daily gain in 1982 for heifer calves was 1.66 pounds and 1.70 pounds for steer calves. These gains were significantly (P .05) higher than for 1980 or 1981 calf average daily gains. The 1980 and 1981 average daily gains were calculated from weight at branding instead of birth weight. Therefore, the significance of these comparisons is questionable since average daily gains for the 3 years were calculated on a different weight basis.

Mean computed 205-day weight for 1982 heifer calves was 409 pounds compared to 420 pounds for Ralgro-implanted steer calves. Weight differences between sexes was not significant. Computed 205-day weight will be the value used in the future to test for a significant difference between years or grazing systems.

Species Composition of Range Cattle Diets

1981 Objective:

Determine the species composition of range cattle diets using forage samples collected from rumen fistulated steers.

1981 Accomplishments:

Samples collected from rumen fistulated steers grazing the Saval Ranch pastures in 1981 were analyzed to determine the species composition of range cattle diets. Pastures sampled included the Upper Sheep Creek, North Forest Service, and South Forest Service pastures.

The fistulated steers grazed each pasture for 9 days before the main cow herd entered the pasture and again for 9 days after the main herd had been removed. Dates for before and after sample periods are given in Table 8.2. The steers were not allowed to graze with the Saval Ranch herd since sorting the research animals from the cow herd is often difficult and time consuming. The "before cattle use" diet was collected in order to determine the most preferred species selected by cattle. The "after cattle use" diet was collected in order to determine the species selected after the preferred species had been utilized.

The steers were allowed to graze approximately 6 hours each day and were kept in a corral at night. Rumen forage samples were collected during 3 days of each 9 day period by the following procedure:

1) contents of the rumen and reticulum were removed and saved in a container,

2) animals were allowed to graze 30-45 minutes,

3) new rumen ingesta was collected, and

4) original rumen and reticulum contents were replaced.

A small subsample was removed from each rumen forage sample. These sub-

samples were oven-dried and sent to Colorado State University (CSU) for botanical analysis to determine percent relative density of plant fragments. Results of this analysis provided an indication of species composition of range cattle diets.

Results of the botanical analysis are shown in Table 8.2. Analysis showed the presence of strawberry and mistletoe in cattle diets. Since these species have not been found on the Saval Allotment, samples were reanalyzed. These data are not available for this report. Therefore, species are reported as originally identified.

Before and after cattle diets collected on the Upper Sheep Creek (USC) pasture showed no difference in the overall percentages of grasses, forbs, and shrubs. The 1981 Saval Progress Report indicated light utilization by the cow herd on areas later grazed by the research animals. Light utilization could explain the similarity in diets consumed by the fistulated animals during the before and after sampling periods.

Species composition of diets in the USC pasture showed little difference in cattle preference between meadow and upland grass and grasslike species within or between the two sampling periods. There was, however, a change in preference of individual species within meadow and upland grass and grasslike species. Percent sedge and bluegrass species from the before to the after diet decreased while the percent rush and mat muhly had the opposite trend. The 1981 Saval Progress Report indicated considerable cattle use of Nevada bluegrass and sedges. This could explain why these species decreased in the research animals' diet after grazing use by the main cow herd. Individual changes in the use of upland grasses by the fistulated steers showed an increase in brome (most likely cheatgrass) from the before to the after diet, while Great Basin wildrye and Thurber needlegrass decreased between sampling periods. Utilization of Great Basin wildrye and Thurber needlegrass by the main cow herd was slight. However, since these species were not abundant in this pasture, even slight utilization could explain a decrease of these species in the fistulated cattle diet for the after period.

Preferred forbs in both diets were tansey mustard and strawberry (most likely a cinquefoil). Ceanothus, antelope bitterbrush, Wood's rose, and mountain snowberry constituted the 3% of shrubs consumed in both diets.

Diets of fistulated cattle in the North Forest Service (NFS) pasture collected after use by the main cow herd showed a 25% decrease in total grass and grasslike species and a 29% increase in shrubs compared to the before diet. Upland grass species constituted 30% of both before and after diets, however, meadow species decreased from 61% in the before diet to 35% in the after diet. Individual changes in meadow species included a reduction in sedge, spikerush, and rush species between the before and after diets while mat muhly slightly increased. Severe utilization by the main cow herd on Wet Meadow, Aspen Woodland, and Aspen Thicket Range Sites in the NFS pasture (1981 Saval Progress Report) could explain the decrease in riparian grass species selected after use by the main cow herd. Forbs also decreased slightly with the largest decrease reported in strawberry (possibly a cinquefoil) comsumption. The only shrub consumed in the before diet was a trace amount of moun-

Table 8.2. Percent (%) relative density of discerned fragments for important species in cattle rumen samples collected on three Saval Ranch pastures during 1981.

Species	Upper Sheep Creek Before use 5/10/81	Upper Sheep Creek After use 6/11/81	North Forest Service Before use 5/26/81	North Forest Service After use 8/9/81	South Forest Service Before use 7/17/81	South Forest Service After use 10/5/81
Grass & Grasslike						
Brome	14	28	20	18	8	12
Sedge	11	6	12	8	18	4
Spikerush	2	1	8	1	T[1]	T
Great Basin wildrye	27	13	6	7	31	37
Rush	13	22	29	12	23	1
Muhly	3	5	2	4	0	0
Bluegrass	16	13	10	10	9	16
Needlegrass	4	3	3	5	6	10
Total[2]	91	92	91	66	95	80
Forbs						
Mustard	2	T	T	0	0	0
[3]Strawberry	1	3	7	2	T	2
[3]Mistletoe	0	0	0	T	0	5
Plantain	0	T	T	1	T	0
Total	4	4	7	5	T	8
Shrubs						
Serviceberry	T	0	0	3	0	T
Sagebrush	T	T	0	3	0	2
Bitterbrush	1	T	0	14	0	0
Rose	0	1	0	2	T	6
Snowberry	T	1	T	8	T	2
Total	3	3	T	29	T	9

1 <1%

2 Due to rounding and trace amounts, total values may differ from the sum of the column values.

3 May be misidentified.

tain snowberry. The 29% shrub comsumption in the after diet included Utah serviceberry, sagebrush, antelope bitterbrush, Wood's rose, and mountain snowberry, as well as trace amounts of ceanothus and low rabbitbrush. Severe utilization of preferred grass and grasslike species by the main cow herd could explain the increase in shrub consumption so early in the year.

In the South Forest Service (SFS) pasture, overall percentage of grass and grasslike species in the diets decreased from 95% before use by the main cow herd to 80% after use by the cow herd. Severe utilization by the main cow herd on Wet and Dry Meadow sites (1981 Saval Progress Report) caused a decrease in availability of meadow species. This resulted in a 19% decrease of meadow species in diets consumed by research animals following cattle use. Upland grass species increased slightly in the after diet.

Changes in individual species in the after diet on the SFS pasture included a 36% decrease in sedges and rushes and a 21% increase in cheatgrass, Great Basin wildrye, bluegrass, and needlegrass. Bluegrass and sedge species received considerable use by the Saval cow herd. Lower availability of these preferred meadow species and a slight fall greenup of some upland species could explain the change in fistulated cattle diets collected after utilization by the main cow herd.

Forbs and shrubs in the after diet on the SFS pasture increased 8 and 9% respectively from the before diet. The increase in forb consumption late in the grazing season was unexpected and difficult to explain but may be due to misidentification of species present. Wood's rose, mountain snowberry, sagebrush, and a trace amount of Utah serviceberry constituted the 9% of shrubs after cattle grazing. The increase in shrub consumption after grazing by the main herd could be explained by the prior cattle utilization of preferred herbaceous species and/or preference of test animals for higher protein sources, such as shrubs, as quality of the herbaceous species declined in the fall.

Range Cattle Diet and Intake

1982 Objective:

Determine species composition, diet quality, and amount of forage consumed by range cattle using rumen fistulated and intact cattle.

1982 Accomplishments:

Samples collected from four rumen fistulated and four intact research cattle were analyzed to determine species composition, diet quality, and amount of forage consumed by range cattle. The pastures sampled during the 1982 season included:

Pasture	Before Use[1]	After Use[1]
1) Lower and Middle Mahala	(4/13-23)	-
2) Control Crested Wheatgrass	(5/4-14)	-
3) Control Native Range	(5/18-28)	-
4) South Forest Service	(6/2-12)	(8/17-27)
5) North Forest Service	(7/19-29)	(10/4-14)
6) East Darling	(10/19-29)	-

Rumen forage samples were collected from the fistulated animals during 3 days of each 11-day period in order to determine species composition and nutritional quality of the diets. The same evacuation and subsample procedures were used as reported in the Species Composition section of this report. The major portion of each rumen sample was sent to the University of Nevada, Reno, (UNR) Nutrition Testing Laboratory and analyzed for percent crude protein, dry matter, acid detergent fiber, and lignin.

Intact steers were bolused twice daily with the external indicator, Chromic Oxide (Cr_2O_3) in order to determine the amount of forage consumed. Fecal grab samples were collected from these animals twice daily on days 6-11 of each sampling period. A subsample of this fecal material and fecal samples collected from the Saval cow herd utilizing the pasture were oven-dried and sent to Colorado State University for botanical analysis. Data from this analysis were used to determine if research animals and range cows consumed similar diets.

The major protion of each fecal sample was sent to the UNR Nutrition Testing Lab and analyzed for the same constituents as for rumen samples in order to determine the digestibility of diets consumed. In addition, fecal samples were tested for their Chromic Oxide (Cr_2O_3) content. Dry matter consumed and digestible dry matter (DDM) were computed using the formulas:

$$\text{Daily DM excretion (gm)} = \frac{\text{gm } Cr_2O_3 \text{ fed daily}}{Cr_2O_3 \text{ per gm of feces}}$$

$$\text{Daily DM consumption (gm)} = \frac{(\text{lignin per gm of feces})\ \ (\text{daily DM excretion})}{\text{lignin per gm of forage}}$$

$$\text{DDM (\%)} = \frac{(\text{daily DM consumption})-(\text{daily DM excretion})}{\text{daily DM consumption}} \times 100$$

where DM = dry matter and gm = gram.

Only one sampling period was conducted on the early BLM pastures. The Saval cow herd grazed these pastures for 2 weeks and a change in diet would not be expected within this short period of time.

---

1 These sampling periods are explained in the preceeding section of this report.

We attempted to begin the nutrition studies March 29, 1982 on the West Darling (WD) crested wheatgrass pasture. Following 5 continuous days of snow, the snow depth prohibited proper grazing by the research animals and this sampling period was termintated. The Control Crested wheatgrass (CC) pasture was later sampled in place of the WD pasture. Since the CC pasture had been used in past years as part of the WD we did not feel there would be a difference in diet between pastures.

The delayed sampling of the CC pasture caused a further change in sampling schedule. The main cow herd was scheduled to be turned onto the Upper Sheep and Upper Mahala Creek pastures before these pastures could be sampled by research animals. Rather than miss the sampling period, the BLM Control Native (CN) pasture was sampled. The CN pasture had been part of the Upper Mahala Creek pasture until fence construction the previous fall.

Sampling of the East Darling pasture scheduled for November 29 through December 9 was also terminated due to snow. The Saval Ranch received a substantial amount of snow during the same period in 1981. It may not be possible to conduct a trial with research animals so late in the year.

The chemical and botanical analyses of 1982 rumen and fecal samples were not completed in time for this report. These results will be reported in the 1982 livestock research progress report.

CHAPTER 9

ECONOMIC RESEARCH (RANCH)

Allen Torell

Baseline Data Collection

1982 Objectives:

Obtain baseline data for use in future analyses.

1982 Accomplishments:

Most of the data required to complete the economic analysis of the Saval grazing system involves estimating changes in biological and physical parameters (i.e. livestock gains, forage production). Therefore, a large part of the economic data will come from other project disciplines such as the livestock and range sections. As a result, a major part of the research effort on the Saval to date has emphasized collection of meaningful physical and biological data as needed for economic evaluation.

Four years of baseline data on forage production, livestock production, hydrology, wildlife and fisheries, and ranch economics have been compiled. The baseline data compiled by the various research groups, pertaining to livestock production and livestock economics, was combined to define the economics of the Saval Ranch without the grazing system. This economic profile of the ranch under season-long grazing provides the base to which management alternatives which include the grazing system can be compared. This "base" must be established to conduct B/C analysis of the grazing system.

Based on SVIM and other information provided by SCS, BLM, and Forest Service, allotment acreage and production data were compiled. The Saval Ranch, including all private and Federal forage sources, was estimated to have a total of 8,688 AUMs of seasonal grazing resource. In addition, an estimated 3,630 AUMs of hay is available for winter feeding (for an average year). The new Lower Sheep Creek seeding is estimated to add an additional 972 AUMs of grazing resource -- bringing the annual total for the ranch operation to 13,290 AUMs.

Average livestock production statistics including herd size, calf crop, death loss, weaning weights, replacement rates, and bull ratios were estimated from conversations with Saval Ranch manager, Mr. Ralph Vance, and from past livestock and economic research conducted on the Saval. Key production parameters include calf wean crop and calf weaning weights. Calf crop was estimated to average 70 percent from 1979 to 1981. Calf weaning weights averaged 362 pounds for steer calves and 356 pounds for heifer calves.

"Typical" annual livestock production costs for the Saval Ranch were summarized from the 2 years of economic data compiled on the ranch. Using price indices, 1979 costs were converted to a 1980 base. From these data, and other ranch economics data compiled by Myer and Hackett (1981) for other Elko County ranches, a "representative" ranch income statement was developed for the Saval (Table 9.1). Total variable costs of production on a per cow basis for the Saval Ranch was estimated at $181. This compares favorably with similiar estimates for "representative" Elko County ranches (Myer and Hackett, 1981). These same cost data are being compiled for the 1982 production year.

Table 9.1. Ranch Income Statement for the Optimal Cow/calf Operation With the Current 627 Head Cow Herd Size.

INCOME				
		$/CWT	LBS.	TOTAL
219	STEER CALVES	80.05	351	61660
94	HEIFER CALVES	68.27	345	22152
107	CULL COWS	44.01	950	44565
8	CULL BULLS	59.43	1400	6886
	GROSS INCOME			135263
PRODUCTION COSTS				
	I. FEED COSTS	$/UNIT		TOTAL
4214	AUMS FED. FORAGE	2.02		8513
1285	ACRES RAISED HAY			
	LABOR	16.73		21501
	FUEL	6.77		8701
	REPAIRS	4.16		5346
	SUPPLIES	2.40		3084
	SUBTOTAL	30.06		38632
0	TON PURCHASED HAY	68.00		0
0	ACRES IRRIG. PASTURE			
	LABOR	8.64		0
	FUEL	0.68		0
	FENCING MATERIALS	0.21		0
	VEHICLE REPAIR	0.49		0
	SUBTOTAL	10.02		0
	TOTAL FEED COSTS			47145

Table 9.1. Continued

II. NON-FEED COSTS	$/COW	TOTAL
627 HEAD OF COWS		
LABOR	50.10	31413
VEHICLE REPAIR	5.00	3135
GAS & OIL	12.67	7944
GENERAL SUPPLIES	3.93	2464
GENERAL MAINTENCE	2.79	1749
OFFICE EXPENSES	0.18	113
ACCOUNTING	0.83	520
VETERINARY & MED.	5.28	3311
FREIGHT & HAULING	2.06	1292
BRAND INSPECTION	0.34	213
SALT & MINERALS	3.30	2069
MARKETING	1.33	834
TOTAL NONFEED COSTS		55057
TOTAL VARIABLE COSTS		102202
III. FIXED COSTS		
TELEPHONE		1865
UTILITIES		13362
INSURANCE		8678
TAXES		6273
DEPRECIATION		37756
TOTAL FIXED COSTS		67934
IV. RETURNS		
RETURNS OVER VARIABLE COSTS		33060
RETURN TO LAND & CAPITAL		-34874

1982 Objectives:

Monitor changes in livestock production costs brought about by the grazing system.

1982 Accomplishments:

One of the big expenses to the ranch of the Saval grazing system will be increased labor costs brought about by increased livestock herding, improvement maintenance, and management. For 1982, ranch labor summaries were compiled by each Saval Ranch employee each week. Each ranch employee recorded on a time sheet the hours spent during the week performing various tasks. These summaries were then compiled on a computer to provide a summary of the labor structure of the Saval Ranch. This summary of labor requirements will serve two primary purposes. First, and most importantly, the labor summary will provide a base upon which ranch labor requirements in future years can be compared to determine how the grazing system affected labor requirements.

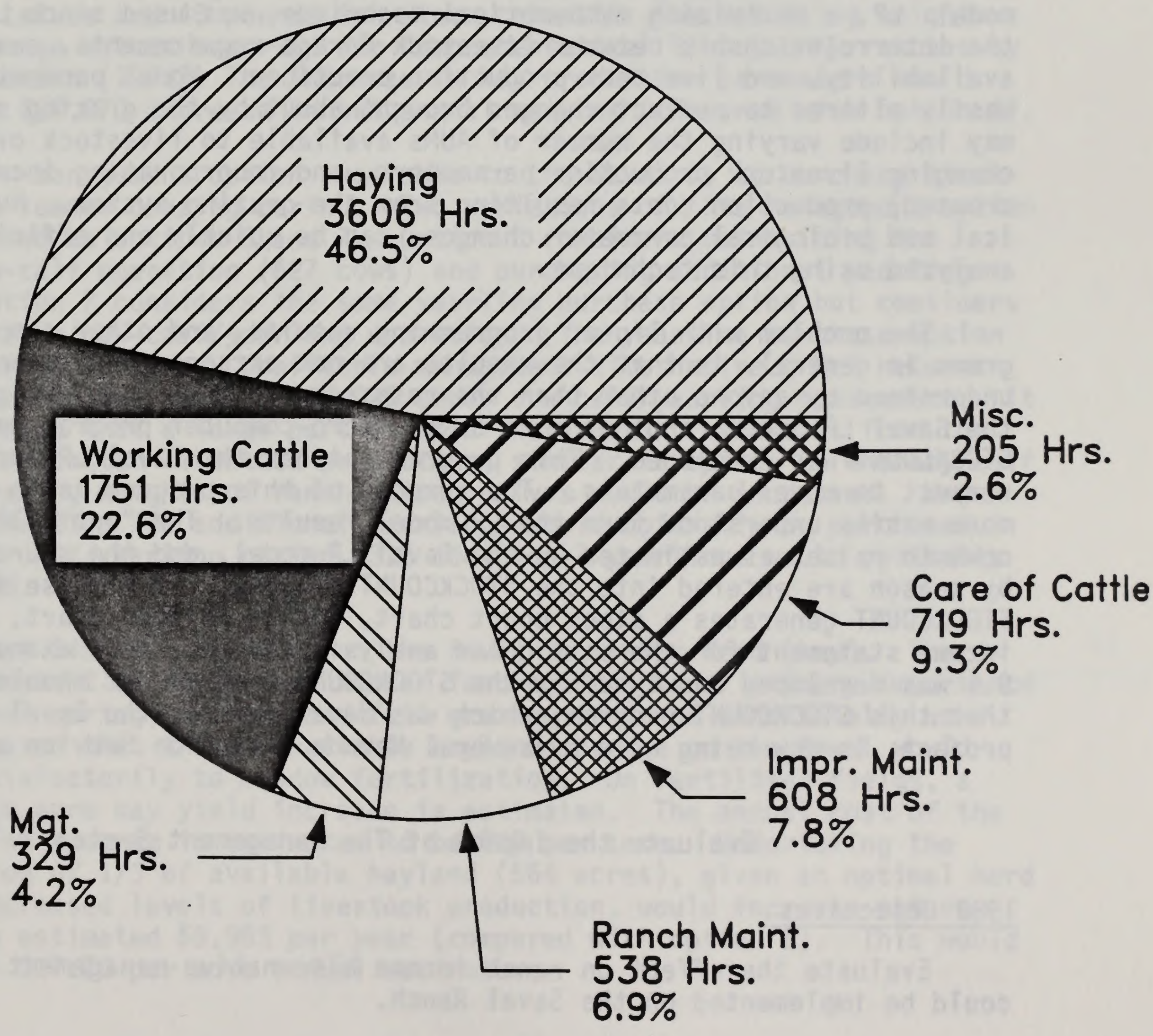
The second purpose of keeping the labor data is to define as a case study, the labor breakdown by task of "what ranchers do for a living." The labor data compiled on the Saval will provide a unique opportunity to break ranch expenses out by ranch activity (i.e. winter feeding, grazing Federal rangeland, grazing private rangeland) rather than strictly on a per cow basis as has typically been done in the past. This will allow the investigation of such questions as: "what is the total cost of grazing Federal rangeland?"

It is anticipated that the labor summaries will only be compiled during 1982 because the time required by ranch employees in compiling the data was judged to be prohibitive. In future years, only the changes in labor for some specific categories related to the grazing system will be compiled.

Figure 9.1 summarizes the labor data compiled for the period May 1982 through October 15, 1982. The general labor categories include haying (e.g. haying, irrigating), working cattle (e.g. herding cattle between allotments, branding, shipping), management, ranch maintenance, range improvement maintenance, care of cattle on range (e.g. checking cattle, pushing cattle to a new section of an allotment), and miscellaneous tasks. By far the largest portion of summer labor was devoted to haying (46.5 percent). Working cattle followed second with 22.6 percent of the summer labor input devoted to this task.

From the labor data gathered, it was estimated that the 1982 interim grazing system resulted in 215 hours of increased herding labor. This is based on the assumption that herding between BLM allotments and herding between FS pastures, as dictated in the management plan, would not be required without the grazing system. This resulted in an increased labor expense to the ranch of approximately $730, based upon a calculated real hourly wage of $3.40 for Saval Ranch employees.

Fig. 9.1 A Summary of Saval Ranch Labor Statistics by General Labor Task for the Period May 1982 to October 1982.



Develop Appropriate Computer Models

1982 Objectives:

Expedite the use of existing computer programs appropriate for the Saval research project. Build a static, single-year linear programming model for the Saval Ranch. Incorporate data collected by other groups and the costs calculated from budget analysis into the model.

1982 Accomplishments:

An economic model was developed for the Saval Ranch. The model incorporates all physical, biological, and economic data compiled on the project to date. Using the model, alternative management strategies for the Saval have been evaluated. For example, the profitability of switching to a cow-calf/yearling operation, fertilizing native hay meadows, and the economics of the new crested wheatgrass seeding recently implemented on the Saval have been analyzed. In addition, an ex-ante look at the economics of the proposed Saval grazing system has been completed. These results are summarized under the next two objectives.

The specific type of model developed is a Linear programming (LP) model. LP, a maximizing mathematical technique, was used since LP captures the interrelationship between livestock forage requirements, seasonal forage availability, and livestock production practices. Model parameters can be easily altered to reflect changes brought about by the grazing system. This may include varying the number of AUMs available to livestock over time, changing livestock production parameters, and incorporating increased (decreased) production costs resulting from the grazing system. Numerous physical and biological parameter changes can be quickly and efficiently analyzed using this technique.

The problem with linear programming results, and other computer programs in general, is that the results are not arranged in a manner easily understood by anyone other than the researcher. Therefore, to go along with the Saval LP model, another more basic micro-computer program called STOCKCOUNT was developed. This program matches the Saval LP model with respect to model parameters. The purpose of this program is to present in a more easily understood form the LP model results. The "optimal" number of cows to raise, as estimated by the Saval LP model, and the sources of forage by season are entered into the STOCKCOUNT program. From these inputs, STOCKCOUNT generates a stock count chart, forage balance chart, and a ranch income statement for the particular analysis at hand. For example, Table 9.1 was developed and typed by the STOCKCOUNT program. It should be noted that this STOCKCOUNT program, which was developed for the Saval research project, is now being used by several Nevada Extension Service offices.

Evaluate the Impact of The Management System

1982 Objectives:

Evaluate the effect on ranch income alternative management options that could be implemented on the Saval Ranch.

1982 Accomplishments:

Using the Saval LP model and the STOCKCOUNT program, alternative livestock management options for the Saval were analyzed. Options considered include optimal livestock production with the current Saval cow herd size of 627 brood cows, the optimal level of production (number of cows), improved calf crop and calf/yearling selling weights, the economics of meadow fertilization, the economics of the new Lower Sheep Creek seeding, and the management alternative of purchasing additional yearlings for the summer grazing period. All of these options were considered under a season-long grazing pattern. Table 9.2 summarizes the results.

With the current herd size of 627 cows, optimal returns are estimated at negative $34,874 (Table 9.1). Switching to a cow-calf/yearling operation, with all steer calves sold as yearlings, was estimated to increase annual returns by $21,018. Further, increasing cow herd size to an optimal number of 689 head with management as a cow-calf/yearling operation is estimated to increase net returns by $25,652 (option 4).

Option 5 considers the question: "what if calf wean crop, through breeding management, could be increased to 80 percent from the current 70 percent, and weaning weights could be increased by approximately 10 pounds for heifer calves and 45 pounds for steer calves?" The resulting weights reflect average values reported for "representative" Elko County ranches by Myer and Hackett (1981). The increase in key production parameters would result in a $27,870 increase in net annual returns (compared with option 4).

Another management option available to the Saval is to purchase stockers for the summer grazing period. Two variations of this management option are considered as options 6 and 7. Option 6 considers maintaining the current cow-calf operation (627 cows) and purchasing additional yearling steers. Option 7 considers the same yearling purchase option but considers management as a cow-calf/yearling operation. The yearling purchase option would appear to be a very profitable management alternative. Net returns are estimated to increase by $65,016 under cow-calf/yearling management. It should be noted that a large part of this increase in revenue is from the assumption of better livestock production, similar to option 5, whereby calf crop and weaning weights of ranch raised calves would be increased. Under cow/calf operation 442 additional yearlings would optimally be purchased. Under a cow-calf/yearling option, 318 additional yearlings would optimally be purchased.

The most limiting resource on the Saval is winter feed (hay). Therefore, development of additional winter feed sources is of primary importance if additional spring, summer, and fall grazing is to be beneficially used. It is estimated that 1/3 of available hayland acreage on the Saval would respond satisfactorily to meadow fertilization. On fertilized fields, a 1.25 ton per acre hay yield increase is estimated. The annual cost of the fertilization program is estimated to be $40 per acre. Undertaking the fertilization of 1/3 of available hayland (564 acres), given an optimal herd size and increased levels of livestock production, would increase net returns by an estimated $9,983 per year (compared with option 5). This would represent a $17.70 per acre annual net return.

Table 9.2. A Summary of the Economics of Alternative Season-long Grazing Management Options for the Saval Ranch.

OPTION NUMBER	MANAGEMENT OPTION DESCRIPTION	OPTIMAL # OF COWS (HEAD)	ADDITIONAL YEARLINGS PURCHASED (HEAD)	RETURN TO LAND AND CAPITAL ($)	CHANGE IN RETURNS FRO OPTION #1 ($)
	CURRENT HERD SIZE, 627 COWS.				
1	COW/CALF	627		-34874	---
2	COW-CALF/YEARLING	627		-13856	21018
	OPTIMAL HERD SIZE				
3	COW/CALF	821		-25979	8895
4	COW-CALF/YEARLING	689		-9222	25652
	OPTIMAL HERD SIZE, INCREASED CALF CROP AND WEANING WEIGHTS.				
5	COW-CALF/YEARLING	670		18648	53522
	CURRENT HERD SIZE, INCREASED CALF CROP AND WEANING WEIGHTS, AND PURCHASE YEARLING STEERS.				
6	COW/CALF	627	442	-1132	33742
7	COW-CALF/YEARLING	627	318	30142	65016
	OPTIMAL HERD SIZE, INCREASED CALF CROP AND WEANING WEIGHTS, FERTILIZE 1/3 OF HAYLAND.				
8	COW-CALF/YEARLING	762		28631	63505
	OPTIMAL HERD SIZE, INCREASED CALF CROP AND WEANING WEIGHTS, ADD THE SHEEP CREEK SEEDING.				
9	COW-CALF/YEARLING	734		24411	59285
	OPTIMAL HERD SIZE, INCREASED CALF CROP AND WEANING WEIGHTS, FERTILIZE 1/3 OF HAYLAND, AND ADD THE SHEEP CREEK SEEDING.				
10	COW-CALF/YEARLING	816		36122	70996

It was estimated that fertilization of hayland would provide more than ample winter feed for the optimal cow herd size of 762 brood cows (option 8). With fertilization, an estimated 669 acres of hayland would be available for fall pasture. As a note of interest, it was also estimated that not only should development of additional winter feed sources be of primary importance for the Saval, but also, without additional winter feed, the proposed Saval grazing system is not estimated to be cost effective (benefits exceed costs) based solely on livestock benefits. This follows from the restrictions of seasonal livestock forage requirements. The most limiting seasonal forage source affects the value of other forage sources available in other seasons.

The new Lower Sheep Creek seeding will soon be available for livestock grazing. With an estimated net forage benefit of 1,282 AUMs from the seeding, and considering a season-long grazing pattern, increased livestock production, and an optimal cow herd size, option 9 indicates an increased annual net return to the ranch of $5,763 from the addition of the seeding (compared with option 5). Without developing additional winter feed to go along with the increased grazing forage, the ranch would be forced to purchase (optimally) 78 tons of additional hay.

Option 10 considers the economics of the Lower Sheep Creek seeding if in addition the meadow fertilization option were also implemented. Under this option, optimal herd size would increase to 816 brood cows. Return to land and management would increase to $36,122. Compared to the current production strategy on the Saval (option 1), the Lower Sheep Creek seeding with meadow fertilization results in a $70,996 estimated increase in net returns.

The reader should note that many of the above results were presented at the Saval Steering Committee meeting held in November 1982 at Elko, Nevada. Based upon recommendations at the November meeting, all of the LP and ranch budget results have been expanded and revised. Thus, the results presented here will be similar but yet different than what was presented in November.

1982 Objectives:

Prepare economic feasibility analysis of the management system proposed for the Saval Ranch. Identify costs borne by and returns obtained by the ranch, agencies, and others.

1982 Accomplishments:

A number of range improvements were implemented on the Saval during the summer of 1981. Improvements included 10.5 miles of new fence, 4 cattle guards, the rehabilitation of 6 reservoirs, and the plowing and seeding of the 2,430 acre Lower Sheep Creek seeding. The costs of these various improvements were estimated and are summarized in a paper titled "The Cost of Range Improvements Implemented in 1981 on the Saval Ranch."

New fence construction was found to average $2,963 per mile. Plowing and seeding costs averaged $32 per acre. Rehabilitation of 6 reservoirs by Forest Service personnel averaged $667 per reservoir. The total estimated agency cost of all improvements implemented during 1981 was $121,925 which does not include administrative costs for the Federal agencies.

Using the range improvement costs outlined above, the Saval LP model to estimate net annual livestock benefits, and following what was thought to be the proposed Saval grazing system, an ex-ante B/C analysis was conducted for the grazing system and recently implemented range improvements. These results were reported at the November Steering Committee meeting. At that time it was pointed out by BLM personnel present at the meeting that Lower Mahala pasture was not included in the early spring grazing rotation as was stated in the Saval Ranch Management Plan. Rather, the various fields of the Darling seeding, the new Lower Sheep Creek seeding, and the Tremewan seeding are rotated on a deferred basis for early spring forage. As a result of this mix-up, the B/C analysis presented at the November meeting and reprinted here is in the process of being revised. All of the following results will undoubtedly change.

The benefit/cost analysis of the grazing system was conducted in a step wise fashion. That is, the net present value (NPV), internal rate of return (IRR), and B/C ratio were all estimated for various levels of range and meadow improvement, and for alternative livestock management options. Table 9.3 summarizes the various alternatives and results obtained.

The first alternative considers the economics of switching to an optimal cow-calf/yearling operation, fertilizing the hay meadows, and adding the grazing system, including the $121,925 worth of range improvements. This "set" of improvements and management adjustments yields benefits of over twice the costs for the 50 year planning horizon considered. The net present value is estimated at $366,678. The IRR is estimated at 36.4 percent--a very good return on investment when compared to alternative investment opportunities.

The second alternative considers implementing the same set of improvements but this time starting with an optimal cow-calf/yearling operation rather than a cow-calf operation. Given this, the B/C ratio is estimated at 1.37, and NPV is estimated at $134,235. When compared with the first alternative, these results would indicate that the switch to a cow-calf/yearling operation alone yields a NPV over the 50 year planning horizon of $232,433 ($366,678 - $134,235).

Alternative three considers the economics of adding just the proposed grazing system given the ranch is already operating as an optimal cow-calf/yearling operation and that 1/3 of available hayland is fertilized. The results indicate that the grazing system as proposed is cost effective. The B/C ratio is estimated at 1.35-- indicating that benefits exceed costs by 35 percent. Net present value is estimated at $70,100 and the estimated IRR is 15.3 percent. But, as mentioned earlier, if hay meadows are not fertilized or if additional winter feed sources are not developed, then NPV is not estimated to be positive for the grazing system. Year-round forage balance is needed to make additional grazing resource beneficial.

The reader is reminded, again, that the results discussed above and presented in Table 9.3 are currently being revised and will change. These results, as well as results for the various season-long management options analyzed for the Saval, are being summarized in a report titled: "Optimal Livestock Production on the Saval Ranch Under Both Season-long Grazing and Under the Proposed Grazing System" by L. Allen Torell, E. Bruce Godfrey, and Richard E. Eckert.

Table 9.3 The Economics of the Proposed Saval Ranch Grazing System Under Alternative Types of Livestock Management and Levels of Meadow Improvement.

MANAGEMENT OPTION DESCRIPTION		B/C RATIO (@12%)	NPV (@12%)	IRR
START WITH:	OPTIMAL COW-CALF OPERATION			
SWITCH TO:	OPTIMAL COW-CALF/YEARLING OPERATION FERTILIZE MEADOWS ADD THE GRAZING SYSTEM -RANGE IMPROVEMENTS -DEFERRED/REST ROTATION SYSTEM	2.14	$366,678	36.4%
START WITH:	OPTIMAL COW-CALF/YEARLING OPERATION			
SWITCH TO:	FERTILIZE MEADOWS ADD THE GRAZING SYSTEM -RANGE IMPROVEMENTS -DEFERRED/REST ROTATION SYSTEM	1.37	134,235	18.8
START WITH:	OPTIMAL COW-CALF/YEARLING OPERATION MEADOW FERTILIZATION			
SWITCH TO:	ADD THE GRAZING SYSTEM -RANGE IMPROVEMENTS -DEFERRED/REST ROTATION SYSTEM	1.35	70,100	15.3

CHAPTER 10

ECONOMIC RESEARCH (NON-FIRM)

Fred J. Wagstaff

1982 Objectives:

1. Study Charter and other Project documents.
2. Develop study plan for economic studies.
3. Meet with principal investigators.
4. Visit project area.
5. Locate input-output information sources.
6. Begin literature search and review of literature.
7. Consult with Study Team and Steering Committee.

1982 Accomplishments:

1a. A thorough review of the Project Charter, program reports, and prior economic studies was made to gain familiarity with the project.

2a. A study plan for range economic studies was prepared, submitted to the Steering Committee, and approved. The major elements of this plan were the off-ranch economics relevant to Project activities.

2b. A contract using Forest Service funds was let to Townsend and Company of Fairfax, Virginia for development of a detailed plan of study of extra market factor evaluation and externalities of Public rangeland use.

2c. Arranged and conducted a symposium on range economic problems using Forest Service funds. The symposium was held at Salt Lake City on August 30, 31, and September 1. It was attended by over 30 range economists and others representing several universities, Government agencies, the livestock industry, and rangeland managers.

2d. A committee of range economists was formed to determine whether a Western regional coordinating committee for range economics could be formed. The idea has received widespread support and formation of a committee appears imminent.

3. Met with the principal investigator in April to discuss my role in the project.

4. Visited the Project area in September to become acquainted with the area.

5. Located input-output studies at the University of Nevada, Reno, and the Intermountain Region of the Forest Service. Both sources will be used and compared. If funding becomes available, a primary data model for Elko County will be done with a cooperating university.

6. Several literature searches were accomplished using the computer facilities and personnel of the Westfornet system of the Intermountain Station of the Forest Service. These results and other sources

have revealed over 600 publications, bulletins, or papers dealing with range and ranch economics. Reading and abstracting of these numerous sources is underway with publication through the Intermountain Station, as planned.

7a. In cooperation with Bill Platts, Fisheries Biologist, prepared a paper on riparian habitat management.

Literature Cited

Myer, G.L. and I.E. Hackett. 1981. Costs and returns for cow-calf enterprise in Elko County, Nevada. University of Nevada. Economic fact sheet E-29-81.

CHAPTER 11

RESEARCH DESIGN, INTEGRATION, AND SYNTHESIS

Peter Lent

1982 Objectives:

1. Develop an overall model of the Saval Ranch system through interdisciplinary input provided in two modelling workshops.

2. Make recommendations for improving research design, hypotheses testing, data management, and interdisciplinary communication.

1982 Accomplishments:

A 153 page contractor's progress report entitled, "Saval Ranch Research Design, Integration and Synthesis - Modelling Workshop Report", was distributed widely in September, 1982, to those involved with and interested in the Saval Project. A very limited number of copies of this report are still available from Peter Lent, Bureau of Land Management (201), Washington, D.C. 20240.

This progress report described the workshop-modelling procedure, and briefly described the components and a few of the principal functional relationships used in the model. It also gave examples of the types of scenarios that can be run in which the model evaluates the possible results of specific management actions on the simple representation of the ranch system. It simulates the effects of specific management actions on the selected indicators over a period of up to 30 years.

It is recognized that this overall system model is still very crude and needs improvement. However, the contractors and Saval project personnel agreed that it would be more fruitful to shift attention in the latter part of 1982 and in 1983 to the development of smaller submodels that could be run on micro-computers, such as the Apple II in the Elko project office. The rationale for developing these was, in part, that personnel relatively unspohisticated in programming and computer use would be more likely to use the simpler submodels. Also, the cost of using such submodels is considerably less than running the whole model on a mainframe computer.

An initial sub-model product ("WATVEG") to predict plant growth in various vegetation types based on precipitation and soil moisture was developed and turned over to the project for further testing and refinement.

A relatively simple, new submodel to predict abundance of key passerine "indicator" species, based on changes in percent cover of principal vegetative layers, was also developed. This simple model is now available for testing and refinement. Indicators relating to non-game birds were not dealt with in developemnt of the overall model due to lack of time. In 1983, this small submodel will be linked up with livestock grazing and other submodels.

Further training of Saval project personnel in facilitating interdisciplinary workshops and modelling will receive high priority in 1983, as is development of an "Apple-sized" model for the riparian system, including privately owned hay meadows.

The contractor's report also contained a list of assumptions used in model building. The contractors believe these are testable hypotheses that could be

addressed at the Saval Project site.

The Annual Saval Project report of April, 1982, included some of the recommendations of the contractors and workshop participants for improving research design and interdisciplinary communication. These recommendations are still considered important.

Finally, the contractors listed eight changes in thinking or direction which they perceive have (or are) occurring as a result of workshops and communication processes;

(1) Major changes in the plans for hydrological research appear to have taken place. These changes seem to have resulted from the apparent differences between the information needs of the vegetation researchers for hydrological data, and data presently generated by hydrologists.

(2) Changes in the methods, units of measure, and perhaps spatial resolution used for vegetation production, livestock consumption, and/or hydrology research seem imminent. These expected changes are a consequence of the demonstrated need for data from research projects to be compatible in space, in time of collection, and/or in the way field measurements are made.

(3) There has been in some cases an adjustment of existing opinion about whether cattle and wildlife are compatible. At project outset, consensus seemed to hold that management for cattle and management for wildlife were generally incompatible, and that determining compromise management options was the prime purpose of the Saval project. But conclusions reached during the workshops strongly suggested that selected range management options could benefit cattle, mule deer, sage grouse, and perhaps other wildlife simultaneously. As an example, increases in habitat interspersion and herbaceous plant production caused by judicious sagebrush control might increase cattle production, songbird diversity, and grouse and deer production.

(4) The importance of understanding population regulation factors for wildlife species became obvious as a consequence of building the model. As a result of this realization it is anticipated that future research will change to focus more sharply on population regulating mechanisms, and on how the Saval grazing program affects them.

(5) Building the model has made it clear that economics analysis, as it currently exists, cannot accomodate values measured in units other than dollars. To develop an analysis that can comment on values in terms other than dollars (as is needed in the case of many of the wildlife species, for example), the economists need dollar equivalents of values that are currently perceived in other ways.

(6) During the course of building the model, it became clear that

environmental changes resulting from the implementation of the Saval Management Plan might be readily overshadowed by the expected annual or seasonal variability caused by weather and other factors; this will make it extremely difficult to separate the consequences of the Saval Management Plan from "normal" change. This points out a major weakness of the program; the lack of control data. Because the program is new, good controls in time are lacking. Moreover, nearby off-site areas potentially available as controls in space probably differ sufficiently from Saval that the comparability of data from the two would be limited. Innovative methods will be needed to provide useful experimental control.

(7) The need for a more sophisticated data-management scheme than currently exists has become obvious. Building the model has emphasized that relatively informal methods of data storage and management that currently exist will hinder effective interdisciplinary transfer and use of data.

(8) The need to more clearly define "quality" in some of the indicators has become evident. For example, it was agreed that songbirds and rodents were important wildlife groups, and that impacts on them caused by the Saval grazing plan should be measured. But a definition of quality in bird and rodent populations that would enable decision-makers to decide if the observed impacts were "good" or "bad" needs to be finalized so research can be appropriately focused.

APPENDIX I

Symbol and scientific and common names for plant species shown in text and tables.

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Tree and Shrub Species	
AMELA	*Amelanchier spp.*	Serviceberry
AMUT	*A. utahensis*	Utah serviceberry
ARTEM	*Artemisia spp.*	Sagebrush
ARLO	*A. longiloba*	Alkali sagebrush (early)
ARTR	*A. tridentata*	Big sagebrush
ARTRT	*A. tridentata tridentata*	Basin big sagebrush
ARTRV	*A. tridentata vaseyana*	Mountain big sagebrush
ARTRW	*A. tridentata wyomingensis*	Wyoming big sagebrush
CHRYS	*Chrysothamnus spp.*	Rabbitbrush
CHNA	*C. nauseosus*	Rubber rabbitbrush
CHVI	*C. viscidiflorus*	Low rabbitbrush
PUTR	*Purshia tridentata*	Antelope bitterbrush
RIBES	*Ribes spp.*	Currant, Gooseberry
RICE	*R. cereum*	Current bush
ROSE	*Rosa spp.*	Rose
SALIX	*Salix spp.*	Willow
SYMPH	*Symphoricarpos spp.*	Snowberry
	Forb species	
ACLA	*Achillea lanulosa*	Yarrow
ALLIU	*Allium spp.*	Wild onion
ASSC	*Aster scopulorum*	Crag aster
CASTI	*Castilleja spp.*	Paintbrush
COLLO	*Collomia spp.*	Collomia
COPA	*Collinsia parviflora*	Little flower collinsia
DESCU	*Descurainia spp.*	Tansy mustard
ERIOG	*Eriogonum spp.*	Wild buckwheat
FRAGA	*Fragaria spp.*	Strawberry
GABI	*Galium bifolium*	Bedstraw
HACKE	*Hackelia spp.*	Stickweed
HYCA	*Hydrophyllum capitatum*	Cow cabbage, waterleaf
IVAX	*Iva axillaris*	Poverty sumpweed
LODI	*Lomatium dissectum*	Carrotleaf lomatium
MESA	*Medicago sativa*	Ladak alfalfa
MEOF	*Melilotus officinalis*	Yellow sweetclover
MECI	*Mertensia ciliata*	Shortstyle bluebell
PABR	*Paeonia brownii*	Peony
NAVAR	*Navarretia spp.*	Navarretia

APPENDIX I (cont'd)

SYMBOL	SCIENTIFIC NAME	COMMON NAME
PHHO	*Phlox hoodii*	Hoods phlox
PHLO	*P. longifolia*	Longleaf phlox
PHORA	*Phoradendron spp.*	Mistletoe
PLANT	*Plantago spp.*	Plantain
POBI	*Polygonum bistortoides*	American bisort
POTEN	*Potentialla spp.*	Cinquefoil
SAMI	*Sanguisorba minor*	Small burnet
SMST	*Smilacina stellata*	Starry false solomon-seal
VIOLA	*Viola spp.*	Violet
WYAN	*Wyethia amplexicaulis*	Mulesear wyethia
	Grass and grass-like species	
AGDE	*Agropryon desertorum*	Crested wheatgrass
AGSP	*A. spicatum*	Bluebunch wheatgrass
AGTR	*A. trachycaulum*	Slender wheatgrass
BROMU	*Bromus spp.*	Brome
BRCA	*B. carinatus*	Mountain brome
BRTE	*B. tectorum*	Cheatgrass brome
Carex	*Carex spp.*	Sedge
ELEOC	*Eleochoris spp.*	Spikerush
ELYMU	*Elymus spp.*	Wildrye
ELCI	*E. cinereus*	Great basin wildrye
ELJU	*E. junceus*	Russian wildrye
FEID	*Festuca idahoensis*	Idaho fescue
HEKI	*Hesperocloa kingii*	Spike fescue
JUNCU	*Juncus spp.*	Rush
MUHLE	*Muhlenbergia spp.*	Muhly
MURI	*M. richardsonis*	Mat muhly
ORWE	*Oryzopsis webberi*	Webber ricegrass
POA	*Poa spp.*	Bluegrass
PONE	*P. nevadensis*	Nevada bluegrass
POPR	*P. pratensis*	Kentucky bluegrass
POSA	*P. sandbergii*	Sandberg bluegrass
SIHY	*Sitanion hystrix*	Bottlebrush squirreltail
STIPA	*Stipa spp.*	Needlegrass
STTH	*S. thurberiana*	Thurber needlegrass

APPENDIX II

Wildlife species mentioned in text and tables.

MAMMALS

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME
Artiodactyal	Cervidae	*Odocoileus hemionus*	Mule deer
Carnivora	Canidae	*Canis latrans*	Coyote
Insectivora	Soricidae	*Sorex merriami*	Merriam shrew
		S. palustris	Northern water shrew
Lagomorpha	Leporidae	*Lepus californicus*	Black-tailed jackrabbit
Rodentia	Cricetidae	*Lagurus curtatus*	Sagebrush vole
		Microtus montanus	Mountain vole
		Peromyscus maniculatus	Deer mouse
	Heteromyidae	*Perognathus parvus*	Great Basin pocket mouse
	Sciuridae	*Eutamius minimus*	Least chipmunk

BIRDS

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME
Galliformes	Tetraonidae	*Centrocercus urophasianus*	Sage grouse
Columbiformes	Columbidae	*Zenaida macroura*	Mourning dove
Passeriformes	Alaudidae	*Eremopila alpestris*	Horned lark
	Fringillidae	*Amphispiza belli*	Sage sparrow
		Chondestes grammacus	Lark sparrow
		Melospiza melodia	Song sparrow
		Passerina amoena	Lazuli bunting
		Passerella iliaca	Fox sparrow
		Pipilo chlorurus	Green-tailed towhee
		Pooecetes gramineus	Vesper sparrow
		Spizella breweri	Brewer's sparrow
	Icteridae	*Sturnella neglecta*	Western meadowlark
	Mimidae	*Oreoscoptes montanus*	Sage thrasher
	Parulidae	*Dendroica petechia*	Yellow warbler
	Troglotidae	*Troglodytes aedon*	House wren
	Turdidae	*Turdus migratorius*	Robin
	Tyrannidae	*Empidonax spp.*	Empidonax flycatcher
		E. wrightii	Gray flycatcher
	Vireonidae	*Vireo gilvus*	Warbling vireo
Piciformes	Picidae	*Colaptes cafer* [1]	Red-shafted flicker
Strigiformes	Strigidae	*Speotyto cunicularia* [1]	Burrowing owl

FISH

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME
	Salmonidae	*Salmo clarki*	Humboldt cutthroat trout (Taxonomic work on this species is not complete, however it is closely related to the Lahontan cutthroat) (*S.c. henshawi*)

[1] Species identified at the Saval Ranch for the first time in 1982.

APPENDIX III

English to metric conversion table for units used in the 1982 Saval Ranch Research and Evaluation Progress Report

To Convert	Into:	Multiply by:
Acres	Hectares	.4047
Feet	Meters	.3048
Inches	Centimeters	2.5400
Miles	Kilometers	1.6090
Number/square mile	Number/square kilometer	.3863
Pounds	Grams	453.5924
Pounds	Kilograms	.4536
Pounds/acre	Grams/hectare	1120.8115
Pounds/acre	Kilograms/hectare	1.1208
Square feet	Square meters	.0929
Square yards	Square meters	.8361
Temperature (°F) -32	Temperature (C)	5/9
Yards	Meters	.9144
Cubic feet/second	Cubic meter/second	.0283
Cubic feet/second/square mile	Cubic meter/second/square kilometer	.0109